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ABSTRACT

This book is the third published collection of scripts written for radio by professional staff and student writers. The writers strived to translate complex technical topics into everyday terms without sacrificing accuracy and to provide listeners with fair and balanced reports on the major environmental and scientific issues of the day. This collection characterizes many environmental trends and concerns reflecting on the multitude of scientific discoveries, inquiries, and innovations that characterized the 1980s. Topics covered in this compilation include: (1) "The Atmosphere"; (2) "The Biosphere"; (3) "The Land"; (4) "The World of Water"; (5) "Energy"; (6) "Environmental Quality"; (7) "Health and Nutrition"; (8) "People and Society"; and (9) "Around the Globe." A teachers' guide written to accompany this collection is included. This guide discusses concept mapping, questioning in the classroom, and infusion of the material into the curriculum; and includes a sample activity. Appended is a brief list of additional information sources. (CW)

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EARTHWATCHING

AN ENVIRONMENTAL READER WITH TEACHER'S GUIDE

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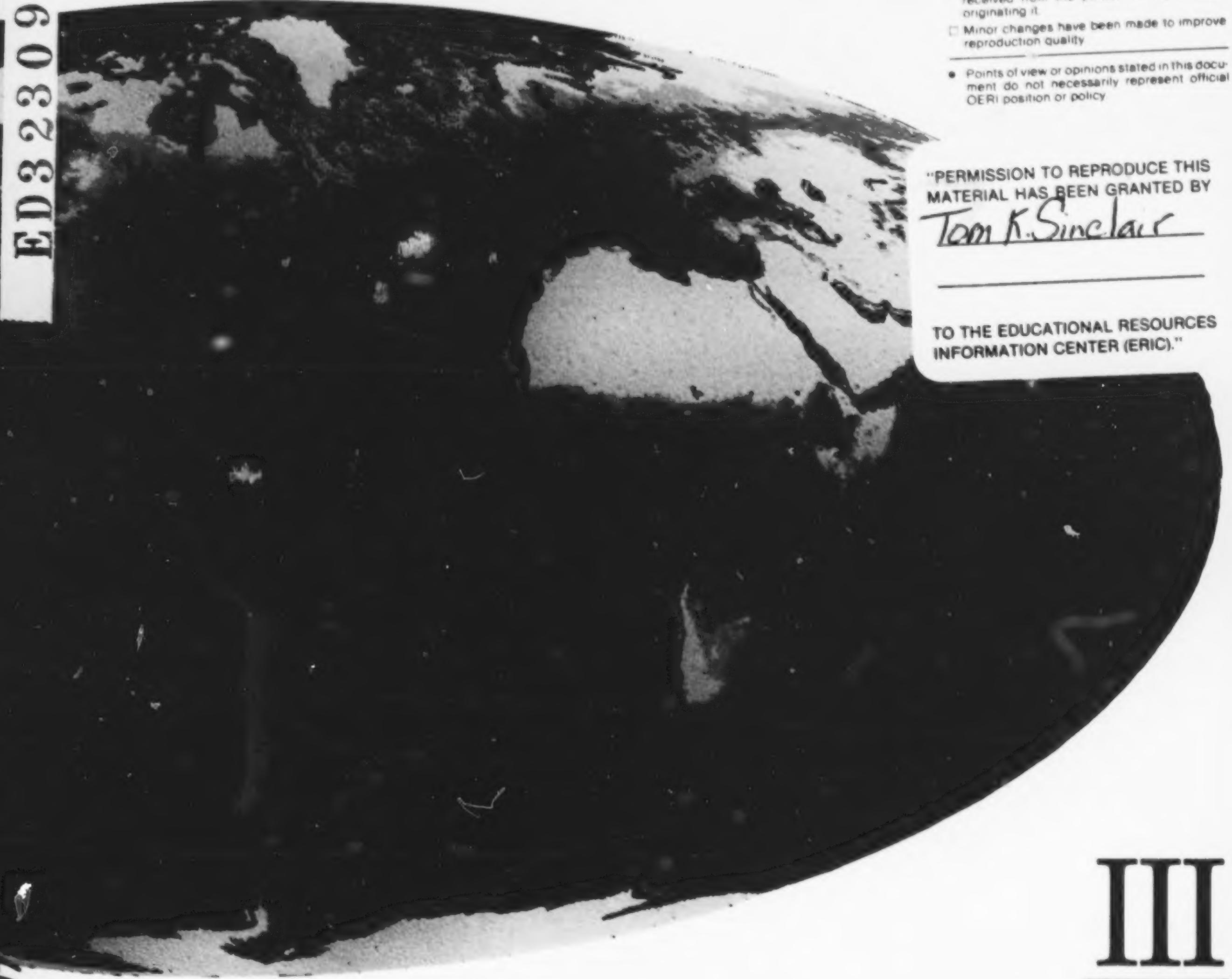

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EARTHWATCHING

AN ENVIRONMENTAL READER WITH TEACHER'S GUIDE

III

Institute for Environmental Studies, University of Wisconsin-Madison
and the
University of Wisconsin Sea Grant Institute
with support from the Evjue Foundation, Inc.

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Contents

- **Acknowledgments** v
- **Preface** vii
- **Introduction** ix
- **Chapter 1: The Atmosphere** 1
  - Climate/Weather 3
  - Pollution 6
- **Chapter 2: The Biosphere** 9
  - Animal Behavior 11
  - Birds 13
  - Conservation 16
  - Fish 18
  - History 21
  - Insects 22
  - Mammals 24
  - Plants 27
- **Chapter 3: The Land** 31
  - Agriculture 33
  - Conservation 36
  - Land Use 39
- **Chapter 4: The World of Water** 43
  - Fisheries 45
  - Great Lakes 47
  - Groundwater 49
  - Oceans 51
  - Pollution 53
  - Recreation 55
  - Rivers 58
  - Water Supply 59
- **Chapter 5: Energy** 63
  - Conservation 65
  - Energy Sources 68

- **Chapter 6: Environmental Quality 71**
  - General 73
  - Hazardous Waste 74
  - Innovations 76
  - Regulation 80
  - Solid Waste 83
  - Urban Growth 87

- **Chapter 7: Health and Nutrition 91**
  - Food 93
  - Health 96

- **Chapter 8: People and Society 103**
  - Culture 105
  - Pioneers 107
  - Population 110
  - Technology 111

- **Chapter 9: Around the Globe 113**
  - Cities 115
  - Conflict 116
  - Development 118
  - Survival 121

- **Teacher's Guide 123**
  - Concept Mapping with *Earthwatching III* 125
    - What is Concept Mapping? 125
    - How to Draw a Concept Map 125
    - Scoring Criteria 128
  - Questions for Classroom Investigation 131
    - Plants and Pollutants 131
    - The Snowflake Man 132
    - Big Blasts and Bumper Crops 132
  - Example Activity 133
    - Activity 133
    - Procedure 133
    - More Questions and Activities 135
  - Infusing *Earthwatching III* into a Curriculum 137
    - *Earthwatching III* and Social Studies 139
    - *Earthwatching III* and Health Education 149

Sources of Additional Information 153

References 153

Subject Index 155

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Peyton Smith deserves special credit: As an enthusiastic young member of the Sea Grant Institute staff in 1972, Peyton helped launch "Earthwatch," and for the next 16 years he wrote hundreds of scripts, edited thousands more, recruited scores of radio stations to the "Earthwatch" network, served as studio announcer and publicist, and consistently stood up for the program at budget time. He also helped set the stage for publication of *Earthwatching III* before leaving the Sea Grant Institute in 1988. His dedication to "Earthwatch" will be long remembered and appreciated.

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Finally, thanks to the 100-plus radio stations in Wisconsin, Michigan, Minnesota, North Dakota, Ohio, Iowa, Illinois, Indiana, New York, and Costa Rica that regularly broadcast "Earthwatch" to millions of listeners.

Preface

It began modestly on a September morning in 1972. A short public service radio program named "Earthwatch" made its debut on a dozen Wisconsin stations with a story about the causes of Dutch elm disease, which at the time was killing off one of the most familiar trees on the American landscape.

Today—17 years and 4,400 stories later—"Earthwatch" is aired regularly on more than 110 commercial and public radio stations in and around the Upper Midwest—in Illinois, Indiana, Iowa, Michigan, Minnesota, New York, North Dakota, and Ohio as well as Wisconsin. One of the longest-running radio programs on the environment anywhere, "Earthwatch" is heard regularly by millions of people. The program has received numerous awards from a variety of organizations, including the U.S. Environmental Protection Agency, Midwest Association for Environmental Education, Wisconsin Natural Resources Foundation, Wisconsin Center for Public Representation, and, most recently, the national Council for Advancement and Support of Education.

"Earthwatch" is coproduced by the Institute for Environmental Studies at the University of Wisconsin-Madison and the University of Wisconsin Sea Grant Institute. Both institutes regard public information and outreach as a fundamental part of their missions because an informed public is essential for making sound decisions on environmental and scientific policies. "Earthwatch" is one of the many ways in which they share their resources and expertise with the public.

The stories are written for radio by professional staff and by student writers interested in environmental and science journalism. Ten new two-minute "Earthwatch" features are recorded every two weeks at the studios of public radio station WHA on the University of Wisconsin-Madison campus. The tapes are distributed free to any radio station that agrees to broadcast them regularly.

As readers of this book will discover, "Earthwatch" covers almost every environmental topic imaginable. The program emphasizes subjects of special interest to residents of the Great Lakes region and north central United States, but it includes a healthy mix of features about other parts of the nation and other parts of the world.

Much time and care goes into researching and writing the stories for "Earthwatch." The staff works hard to translate complex technical topics into everyday terms without sacrificing accuracy and to provide listeners with fair and balanced reports on the major environmental and scientific issues of the day.

Earthwatching III is the third published collection of "Earthwatch" scripts. It features the program's best stories from recent years. The scripts in this book touch on many current environmental trends and concerns. They also reflect the multitude of scientific inquiries, discoveries, and innovations that characterized the 1980s.

The more recent scripts also reflect the evolution of the program itself in that they feature an introduction line—we call it a "teaser"—that precedes the announcer's greeting and the "Earthwatch" musical bridge before the main part of the story. These teasers appear in bold italics.

Because the topics it covers are so broad and interrelated, there is a great deal of interconnectedness in *Earthwatching III*. Readers are advised to look beyond the most obvious chapter and scan other sections of the book when searching for scripts on a particular topic of interest.

Although *Earthwatching III* is tailored for teachers and students, it is by no means intended only for schools. We hope libraries, nature centers, museums, civic organizations, and church groups as well as individuals will find *Earthwatching III* an informative and readable "sampler" of contemporary environmental knowledge and issues.

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Introduction

Before producing *Earthwatching III*, we asked environmental educators whether they thought a book like this would be useful to their work. All responded with a resounding "yes." They also suggested ways to make the book even more useful than volumes I and II of *Earthwatching*, published in the 1970s. Their ideas have been incorporated into *Earthwatching III*, and we hope they will encourage its use in the classroom.

If you are a teacher, keep in mind the following:

- Use *Earthwatching III*'s scripts and teacher's guide in whatever ways make the most sense to you. The book can be used as a reference and a reader, or as a source of ideas for student reports and debates, environmental topics to use in your curriculum, examples for analyzing how to write radio scripts, quick reading assignments, and more. You could even ask students to update a script as a research project.
- Teachers who reviewed the first two *Earthwatching* books felt they were most appropriate for reading assignments in grades 4-12. Most recommended them as optimum for use in grades 5-8. Reviewers said the scripts were excellent for helping students expand their vocabularies by looking up unfamiliar words in the dictionary. You are welcome to make copies of any script in this book for use by your students.
- You need no science background to use *Earthwatching III*. In fact, we encourage teachers of art, health, math, history, social studies, and other subjects to use "Earthwatch" script topics in their classrooms at all grade levels. See the teacher's guide for ideas about how to integrate environmental topics into your curriculum.
- Because "Earthwatch" is produced at the University of Wisconsin, many scripts are Wisconsin-oriented. However, elements of these scripts can be adapted to similar environmental issues in other states.

The state of Wisconsin actively promotes environmental education in schools through a teacher certification rule requiring environmental education competencies, a school district standard requiring a written sequential curriculum plan that includes environmental education, and the publication of *A Guide to Curriculum Planning in Environmental Education* (Engleson 1985). For more information about the rules and curriculum guide, contact the Wisconsin Department of Public Instruction, Box 7841, Madison, WI 53707.

In light of the important environmental education goals set by the Wisconsin Department of Public Instruction (DPI), we have tried to show how *Earthwatching III* can be used to address DPI's requirements for integrating environmental content into the curriculum. We hope this will help Wisconsin teachers develop curriculum plans and classroom activities that include the topics addressed in this book; however, the appendices are designed to be useful to educators in all locales and contexts.

1: The Atmosphere

NOAA

■ No Previous Experience

The world's climate appears to be changing, and the changes may go beyond anything we've experienced.

Scientists are forecasting weather patterns in the next century that will be much different from those that shape our lives today.

Meteorologist Francis Bretherton of the National Center for Atmospheric Research has worked on a government study of the implications of global climatic change. Bretherton says human activity—especially the burning of fossil fuel—is altering the atmosphere to an unprecedented degree.

Burning fuels like coal and oil injects carbon dioxide into the atmosphere, and carbon dioxide traps solar energy. Bretherton says atmospheric levels of carbon dioxide have increased noticeably in the past 25 years, and they may double in the next 50 years. The result, he says, may be an increase of three to five degrees Fahrenheit in average global temperatures.

Such a temperature increase may seem small, but Bretherton says it equals the warming that has occurred since the peak of the last ice age 18,000 years ago.

> *Changes of this type have never occurred that quickly in the history of the Earth, but more importantly they haven't occurred within the historical experience of human civilization. And a lot of the way we live is built upon assumptions—about the climate, the temperature, the rainfall—of the parts of the world in which we live.*

Bretherton says changes in temperature and rainfall could have serious social and economic consequences. For example, the agricultural Midwest might become a permanent dust bowl, and the Canadian arctic might warm up and become more hospitable to human settlement.

■ ***January 1988***

■ Big Blasts and Bumper Crops

A large volcano near the equator erupts in the spring, catapulting debris high into the atmosphere and creating a narrow band of ash that circles the globe. That autumn, farmers in the U.S. harvest a near-record corn crop. Any connection?

Paul Handler thinks so. The University of Illinois meteorologist is studying how volcanic eruptions affect the world's weather. Handler says the data show that volcanic ash released during some eruptions is strongly tied to unusual changes in climate, changes which in turn may affect agriculture.

> *Associated with the injection of a volcanic aerosol, one sees large climate deviations all over the world, from India to Australia to South Africa, from frost in Brazil to a good corn crop in the United States.*

In 1975, Handler also noticed a correlation between warm surface waters off the Peruvian coast, a condition known as "El Niño," and varying wheat harvests around the world. Weather data revealed that most El Niños follow a volcanic eruption near the equator.

These records indicate this is not a recent phenomenon, and Handler cites a well-known example.

> *The results also agree with the observations after the Krakatoa eruption in 1883, when the sea-surface temperatures became warm in 1884 and 1885.*

Such powerful eruptions wreak havoc for miles around and can adversely alter the climate worldwide. But the clouds of ash spewed from these gigantic explosions do have something of a silver lining.

After studying records from 1866 to the present, Handler says there is indeed a strong relationship between volcanic eruptions near the equator and bumper corn crops in the United States.

■ ***May 1984***

■ Microbursts, Macro-Trouble

Sailors call them point winds. Pilots call them wind shears. To meteorologists they're microbursts or downbursts. But whatever you call them, they mean trouble.

Microbursts are highly concentrated gusts of wind that can form at the leading edge of storm fronts, usually cold ones. These winds blow straight toward the ground and sometimes reach speeds of more than 150 miles per hour, though they seldom last more than a minute. When microbursts occur over water, they can whip up sudden, extremely high waves.

A microburst probably caused an unusual occurrence this year on the Pennsylvania shore of Lake Erie. Witnesses reported that a single huge wave crashed ashore during the night. When officials investigated in the morning, 30 feet of beach had disappeared. Water and sand covered a road, and logs as large as telephone poles were strewn about.

Theodore Fujita, a meteorologist and microburst expert at the University of Chicago, says most of these powerful gusts of wind strike without warning: There is no way to tell if a storm could produce one simply by looking at the clouds. But Fujita and other weather researchers are working with sophisticated Doppler radar that may help detect microbursts. Doppler radar gives detailed information about the wind patterns that form inside clouds. Fujita thinks it may help spot microbursts, but he adds that the special radar will not be available in most areas until the 1990s.

Microbursts can spell disaster for boaters. The powerful gusts often catch sailboats with their sails still set and can tear the masts off even the largest ships. The sudden high waves they create can easily swamp most smaller recreational boats. The best advice, experts say, is to be a prudent boater and stay off the water when storm fronts approach. ■ ***October 1984***

■ Behind the Drought

As a relentless drought grips much of Africa, scientists sift for clues to how long it will last and what's causing it.

Famine plagues dozens of African nations and has reportedly claimed the lives of more than 200,000 people in Ethiopia alone. The famine is rooted partly in a drought that began 17 years ago and never ended. Dry spells are natural in many parts of Africa, but none of the previous ones this century have lasted so long or been so severe.

Most meteorologists think the current drought is a natural fluctuation in Africa's climate and that wet weather is bound to return. But others are not so sure. They wonder if human activities, including widespread cutting of trees and overgrazing of farmlands, have altered rainfall patterns and made the drought more or less permanent. That's speculation, though, because nobody really knows what causes Africa's droughts or determines their length. Most scientists believe complex, highly variable interactions between the atmosphere and oceans are the driving forces. But they do not know how specific factors like wind, temperature and air pressure figure in. Nor do they know whether the mechanisms that trigger droughts are the same as those that maintain them over time.

Some U.S. researchers believe they've found links between droughts in Africa and changes in sea-surface temperatures in the Atlantic and Pacific oceans. Others claim to have evidence that although human activities on the land may not initiate droughts, they could prolong them.

It will be a long time before anyone can say with certainty just what causes Africa's droughts. Even then, droughts are so large in scale that people will probably never be able to control them. But if we could at least predict them, we might be better able to prepare for them when they come.

■ ***June 1985***

Numbers and Raindrops

Meteorologists and mathematicians ponder precipitation.

You leave work and walk into a downpour. But you get home and your neighbor says it hardly rained. What happened? Frank Richards of the National Weather Service says summer storms often have pockets of extremely heavy rainfall. These pockets typically appear during storms that involve very warm, moist air from the Gulf of Mexico. Richards says the storms usually develop when this warm air hits cooler air. Currents within the warm air can then concentrate rainfall in certain parts of the storm.

This phenomenon has been known and studied for decades. One of the most detailed studies was done back in 1942 after an intense 12-hour storm doused the region around Smethport, Pennsylvania. Thirty-six official rain gauges, scattered over 5,000 square miles, showed that eight inches of rain fell during the storm. But Richards says an engineer surveyed hundreds of less formal gauges—such as buckets, troughs and other containers—and found that 30 inches of rain had fallen in some areas.

Richards says mathematicians are looking closely at these pockets of extreme precipitation to figure out statistical formulas that could predict the local effects of this concentrated rainfall. Such information could help engineers design dams and other structures to withstand high water and other after-effects of rainstorms.

Meteorologists can identify conditions that produce pockets of intense rainfall, and the Weather Service is establishing a nationwide radar network to examine these events more thoroughly. But despite growing interest in this phenomenon, Richards says these pockets of precipitation are complex and random, and it may never be possible to predict exactly when and where they will occur. ■ ***August 1988***

The Gales of November

When late fall comes to the Great Lakes region, residents are on the watch: The storms of November and December can be killers.

Fall storms are taken seriously around the Great Lakes region, and well they should be. Some of the most deadly storms in the region's history have battered the Great Lakes in late fall, sinking ships, killing scores of people and causing great damage to property.

But is it just legend that weather at this time of year is more severe than at other times? According to Lyle Horn, professor of meteorology at the University of Wisconsin-Madison, the answer is both yes and no. Horn says storms in late fall are severe and have predictable paths, but he adds that some human factors influence our perception of fall weather. One such factor Horn notes is shipping.

> *If you live in the Great Lakes area, the ships are still on the lakes in the shipping season in November, whereas in March the lakes are closed to shipping, so you tend to hear more, at least as far as Lake Michigan or any of the Great Lakes traffic is concerned, about November storms than March storms.*

Horn says the typical fall storm forms in the Rocky Mountains and then swings southeast, picking up moist Gulf air before heading north. The storm's frigid air mass kicks up large waves as it hits the warmer waters of the lakes.

Some fall storms have become legends, like the Armistice Day storm of 1940. Several ships foundered and some 40 hunters froze to death along the Mississippi River. More recently, the giant ore carrier *Edmund Fitzgerald* broke up in a November 1975 storm, taking 28 sailors to the bottom of Lake Superior with her. If you're headed outdoors this time of year, take precautions and check the forecast before you go. ■ ***November 1986***

For Clearer Skies

One of the goals of the national park system is to preserve pristine natural areas for future generations. But it is becoming more difficult to fulfill that goal as areas just outside national parks are developed and as pressure mounts to exploit the parks themselves for oil, gas and minerals.

Perhaps the most serious threat to many parks these days is air pollution. Nearby power plants, industries and automobiles spew out smoke and dust, and the wind blows it into the parks.

The so-called Golden Circle of national parks in Colorado, Utah, Arizona and New Mexico is especially plagued by pollution from outlying power plants. The parks are situated along the Colorado River and are renowned for their breathtaking canyons and towering plateaus. Visibility in these parks once averaged 60 miles. Now it averages about 40 miles. At times, it is even impossible to see from one side of the Grand Canyon to the other, a distance of only 15 miles.

People concerned about air pollution in the Golden Circle have proposed that the government create a buffer zone around the parks by purchasing land where possible and regulating its use. New power plants and factories would have to be built outside the buffer zone, far enough away that they would not pollute the parks, but that would be both expensive and controversial.

Just what, if anything, should be done about air pollution in the national parks really depends on how we settle a bigger series of questions: To what extent should we preserve the wildness of the parks for posterity? Should we permit their exploitation to meet the material demands of society? If so, are we willing to set limits?

■ ***January 1983***

Plants and Pollutants

It's no secret that air pollution can make people ill. But did you know it can also take a toll on plants? One Wisconsin scientist says air pollution may reduce yields of some farm crops by as much as 20 percent.

Sulfur dioxide and ozone are the air pollutants that most commonly harm plants. Sulfur dioxide results from the burning of fossil fuels such as oil and coal. It is troublesome mainly near factories and power plants. Ozone, on the other hand, is a by-product of automobile exhaust and is much more widespread.

Theodore Tibbitts, a horticulture professor at the University of Wisconsin-Madison, says these pollutants seldom kill plants, and they usually do not harm their flowers or fruit. But he says they do injure leaves, and that's where the trouble begins.

Sulfur dioxide and ozone can enter a leaf through pores on its surface. Once inside, the pollutants disrupt the photosynthetic process in the leaf. This stunts the growth of leaves and can reduce the yields of many crops.

Air pollution is not the farmer's biggest worry. Tibbitts says drought, floods, frost, insects and disease can all take a bigger toll on crops, and the farmer, understandably, is more concerned about coping with those threats.

Nevertheless, says Tibbitts, air pollution's effects on plants are a legitimate concern. He says planting more tolerant crops in polluted areas could help. But the most important thing, he says, is to control pollution from industry and automobiles in the first place. ■ ***May 1982***

■ Star Light, Star Bright

Stargazing in a city usually is not a very successful venture. City lights brighten the sky and wash out the view of the stars. Astronomers call this "light pollution," and in some areas it threatens their work.

Arizona is home to the largest concentration of optical telescopes in the world. The state's dry, clear weather is ideal for observatories. But Arizona also has one of the fastest-growing populations in the United States, and the light from its cities and towns is spreading. Astronomers in Arizona have launched an anti-light pollution campaign. They are asking cities and counties to enact laws to protect the darkness of the nighttime sky. Four counties already have done so.

The light-pollution codes restrict the use of unnecessary lights. For example, the codes mandate limited lighting hours for athletic fields, billboards and parking lots. The codes also set requirements for new outside lamps. They encourage cities to replace old mercury-vapor street lamps with the newer, low-pressure sodium-vapor lamps that do not cause as much light pollution. William Robinson is an engineer for Kitt Peak National Observatory in Tucson. He says it makes economic sense for communities to switch because the sodium-vapor lamps use 60 percent less energy than the mercury-vapor lamps.

Robinson says the public has been fairly receptive to light-pollution laws in Arizona. The governor of the state supports the codes and has urged the astronomers to carry their campaign throughout the state. If they are successful, the cities of Arizona may continue to grow with less effect on the bright, starry nights of the desert sky.

■ ***June 1982***

■ The Smog's on the Other Flue

Ugly brown smoke often clouds the scenic Pacific Northwest, Alaska and the Rocky Mountain states in winter. It hides the stunning natural beauty that made those regions famous. But the smog doesn't always come from industries and automobiles. More and more often, wood stoves and fireplaces are the culprits. Ironically, they heat the homes of those who moved there to get closer to nature.

Oregon considers smog from burning wood an acute problem, and it passed a law last year requiring all wood stoves sold after 1986 to have catalytic converters or dual combustion chambers to reduce their smoke.

Smog has marred Missoula, Montana's scenery for years. Pulp, lumber and paper companies used to be at fault, but the blame has shifted. While Missoula's industries cleaned up their emissions, residents turned to wood heat. Lately, up to 70 percent of Missoula's airborne pollution has come from wood-burning. The city asked its citizens to douse their fires voluntarily when pollution levels were high, but most people refused, so Missoula passed a law ordering them to do it.

In the ski resort of Aspen, Colorado, developers can install only one traditional fireplace in every new structure they build. That means Aspen's condominium buildings can have only one unit with a fireplace. The rest have to make do with clean-burning wood stoves.

Smog isn't a problem yet in Beaver Creek, Colorado, but local officials aren't taking any chances. They've banned wood stoves and linked all fireplaces to a central computer. If air quality ever drops below a certain level in the town, a red light next to each fireplace will signal the owner to smother the fire. A heat sensor in the chimney will check for compliance, and people who ignore the order will face a $500 fine. ■ ***January 1984***

Acid Revelations

We know a lot about acid rain, but we still don't know everything.

Extensive government research on acid rain has confirmed what many scientists and environmentalists said all along: Much of the rain in the United States and Canada, particularly in the East, is more acidic than normal. And two air pollutants, sulfur dioxide and nitrogen oxides, are to blame. Coal-burning power plants and heavy industry produce most of the nation's sulfur dioxide pollution. Car and truck exhaust and power-plant emissions are the primary sources of nitrogen oxides. Every region of the country contributes to the pollution, but the industrial states of the Ohio River Valley are the biggest offenders. All of this information comes from the U.S. Environmental Protection Agency, which, under the Reagan administration, has been very careful not to overstate the problem.

The EPA says the effects of acid rain are still unclear. Biologists generally agree that acidic water can keep fish, frogs and other small aquatic animals from producing normal eggs. It's also suspected that acid rain may kill such animals, either directly or by washing toxic metals like mercury out of the soil and into the water. Yet it's still a mystery why some lakes in places prone to acid rain are highly acidic and lifeless while others in apparently similar settings are not.

On land, acid rain has been accused of harming forests and crops, though the EPA says there's little evidence of that. Government scientists acknowledge that acid rain eats away at building materials ranging from marble to steel. But they say how much it does so, compared to other forces of weathering, is uncertain. Federal officials say they want answers to those kinds of questions before they take any action to prevent acid rain.

■ ***August 1986***

Cancelling a Chemical

Industry pulls a product off the shelf to keep it out of the stratosphere.

Home insulation, air conditioner coolant, even plastic hamburger containers—these are all made with chemicals called CFCs. CFC stands for chlorofluorocarbons, a group of chemicals that is not toxic, flammable or corrosive. But scientists have discovered that CFCs do have a serious drawback: When they escape into the air, CFCs rise into the stratosphere and attack the atmosphere's layer of ozone. Ozone is a gas that shields us from the sun's ultraviolet radiation.

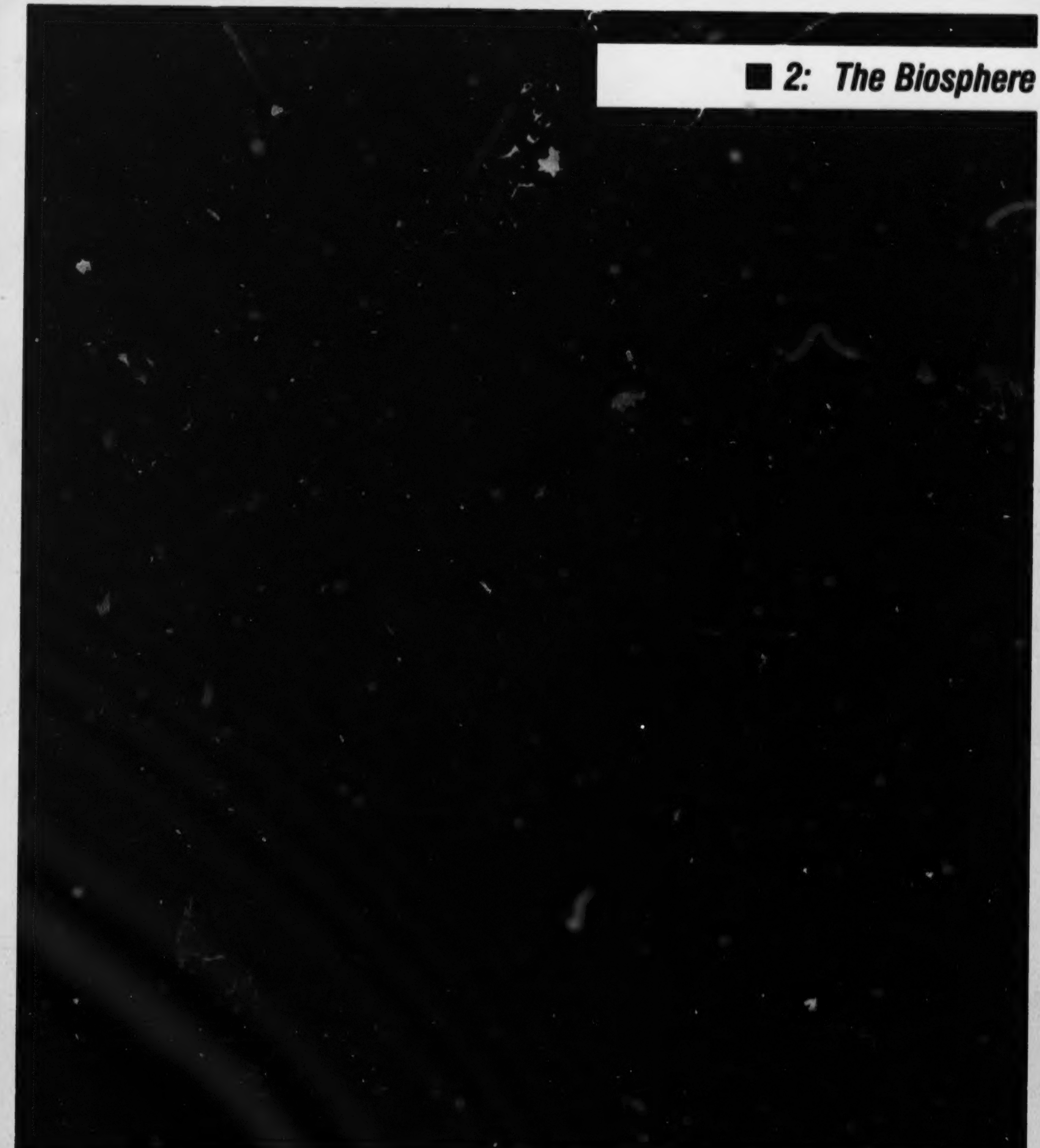
The United States signed a treaty last fall to cut back production and use of CFCs. CFC use is supposed to be cut 50 percent within 10 years. The treaty goes into effect gradually. James Wilbur, chemical analyst with the investment firm of Smith, Barney, Harris and Upham, says this will limit disruptions to the U.S. chemical industry and to consumers.

> *This will give industry a chance to respond to this slowdown in production by finding alternate materials to substitute for the CFCs. So the immediate impact is really quite small, and the longer-term impact will be absorbed by a slow transition of the various companies involved into alternate materials.*

Chemical industries are working on a substitute for the most common CFC, known as CFC 12, which is used in coolants for air conditioners and refrigerators. And companies are already cutting back production and use of other CFCs. By the end of this year, for example, U.S. food service and packaging companies will no longer use packaging that contains this destructive chemical.

■ ***July 1988***

■ 2: The Biosphere



Mike Rebholz

■ Stranded

Some animals spend their whole lives in water but come ashore to die. For centuries, scientists have wondered why.

Since July, more than 200 bottle-nosed dolphins, victims of an epidemic, have landed along the Atlantic coast. Though some died from disease in open water and washed in with the waves, others came ashore sick. Scientists wonder whether those animals chose to ground themselves or whether they made a mistake in navigation.

Kenneth Norris studies the biology and history of marine mammals at the University of California in Santa Cruz. He says many scientists believe sick whales and dolphins *choose* to come ashore because most end up on sandy beaches. He says if sick mammals made mistakes in navigation, more would be stranded on rocky coasts.

> *There is a little bit of evidence that they do know where they're going because they strand more frequently on the beaches than on rocky coasts, where they're simply pounded to death.*

Norris says a sick mammal might choose a soft beach and come ashore to escape drowning. Whales and dolphins sometimes help keep a sick member of their group afloat: If an animal lacks that support, Norris says it might seek a beach instead.

But on the flip side, marine mammals need water as much as they need air. They become stressed within minutes on land. They can neither regulate their body temperatures nor move back into water. And they can suffocate under their own weight. Norris says the majority of sick mammals could be dying at sea but we observe only those that come ashore.

The Greek philosopher Aristotle observed beached whales 23 centuries ago and wrote that they run themselves aground for no obvious reason. Norris says it is still not obvious why marine mammals strand themselves. ■ ***October 1987***

■ It's a Jungle Out There

It appears that animals, like humans, have a lot to learn before they can make it on their own.

As populations of endangered species dwindle, scientists are trying to preserve them by breeding the animals in zoos and research centers. The animals will be released into the wild in hopes that they will thrive again without human help.

University of Wisconsin-Madison zoologist Charles Snowdon says such programs are more difficult than anticipated. The main reason, he says, is that many animal instincts are not as strong as people had thought.

> *What we're discovering, which is very important, is that fear of predators is not innate but has to be taught; that the ability to become a good parent, to show maternal and paternal behavior, is not innate but has to be taught. There are a whole variety of things that people have made assumptions about.*

The assumptions are wrong, says Snowdon, who himself breeds rare monkeys. He says scientists must train animals raised in captivity in basic survival skills.

> *Animals in captivity have to be provided with a sufficiently complex social environment to acquire all of these various socially transmitted things—social communication, parental care, perhaps even proper sexual behavior.*

Snowdon says this may require enclosures large enough to accommodate several generations of an animal so the young can learn from the old. For example, he instills a fear of snakes in his captive monkeys by putting a lifelike model in the cage with them. The young animals learn to react by watching their elders. They gain knowledge that may save their lives in the wild.

Snowdon says the mark of a successful captive breeding program is not how many animals are born, but how many can survive on their own once they're released. ■ ***November 1986***

■ Learning from Lies

Deception among animals may reveal truths about the way their minds work.

Studies of animal communication frequently assume that animals are honest with members of their immediate social groups. But researchers are uncovering examples where animals deceive others to gain individual advantages. Some animals try to conceal information; others try to give false signals. Individuals that get caught lying or bluffing may lose credibility. And individuals that repeatedly detect false information may become skeptical.

Two University of Pennsylvania psychologists, Dorothy Cheney and Robert Seyfarth, found that members of a captive group of African monkeys became skeptical after hearing false alarm calls from another individual. Cheney and Seyfarth say the study of animal deception is relatively new and could help us understand how animals think.

Seyfarth says more evidence of animal skepticism or the use of deception would strongly suggest that animals have sophisticated mental capacities.

> *If I'm going to lie to you, I have to carry around in my mind a notion of what truth is, a notion of what a reasonably acceptable falsehood would be and a notion of how presentation of falsehood rather than truth would affect your behavior. If you could ever find any evidence that animals deceive one another in the sense that humans deceive one another, then you would have really definite evidence that animals are doing some fairly complex cognitive operations in their social interactions. The study of deception, which focuses on the study of communication, is a study in which we use communication as a kind of window on animal minds.*

Seyfarth and Cheney say animal deception may be a sign that animals can think, reason and plot strategies. ■ ***September 1987***

■ The Price of Poaching

Ivory poachers do more than kill elephants in Africa; they kill the way elephants learn to be elephants.

The value of ivory has risen so much that some speculators buy it as a hedge against inflation. High ivory prices have also promoted poaching and created a serious threat to African elephants.

Diana McMeekin, vice president of the nonprofit African Wildlife Foundation, says poachers kill tens of thousands of African elephants every year. An estimated 700,000 elephants still roam Africa, but McMeekin says many of them are babies or juveniles.

> *The poachers are going after the older, larger animals with the larger ivory tusks, and they are leaving behind groups of animals who are without leadership.*

McMeekin says this can be devastating because elephant offspring are much like human infants: They depend heavily on their parents.

> *They have to learn how to be elephants. They can walk when they're very small, but other than that they're just like human babies. They suck their trunks when they're nervous, and they depend totally on their mothers and their adult female relatives for about 13 years of their lives before they are independent at all. And even in the case of the females, they stay with their mothers and their aunts all of their lives. So when they lose the adults, they lose the culture of being elephants, and we're now seeing groups of babies and juveniles and teenagers huddled together in confused little lumps, just wandering around, not knowing what to do to take care of themselves.*

McMeekin says those elephants will be vulnerable to predators and natural calamities. She says they also may be unable to reproduce.

To reduce the financial incentive for poaching, the African Wildlife Foundation is asking American consumers to stop buying ivory. ■ ***July 1988***

■ Decoding Dolphinese

Humans have successfully trained dolphins to perform tricks. Now scientists want to get on to the more serious business—teaching them to talk.

Scientists at the Kewalo Basin Marine Mammal Laboratory in Honolulu were among the first to train dolphins in an artificial language that uses hand signals and computerized sounds. Researchers there also have found that dolphins are sensitive to many subtleties in a language.

Kewalo Basin psychologist James Ralston specializes in dolphin hearing and speech perception. He says dolphins are sensitive to syntax, the order of words. Much as humans know the difference between a Venetian blind and a blind Venetian, dolphins know the difference between taking a surfboard to a ball and a ball to a surfboard.

Ralston says this has encouraged scientists to go one step further in dolphin communication. At Kewalo Basin Laboratory, the scientists are ready to train two dolphins to communicate with them.

> *The goal of our current project is to train them so we can have a two-way flow of communication; that is, we can give messages to them and they can give messages to us.*

Ralston is designing a set of sound symbols that both humans and dolphins can use to communicate with each other. Since dolphins vocalize in high-frequency squawks and whistles, Ralston is creating a language that matches a dolphin's capabilities. He will use a keyboard synthesizer to mimic the sounds. Ralston hopes to create a language *similar* to the dolphin's, but he does not want to *duplicate* their natural language and confuse them.

Ralston says training the dolphins to use an artificial language could be relatively easy. He says dolphins are curious, and they appear as willing to communicate with us as we are with them.

■ ***October 1987***

■ Magnetic Migration

Spring is on its way. The weather is warmer, the snow is melting and the first robins are returning north. But how do those birds know which way to go?

Billions of birds migrate, some traveling thousands of miles. And each year something guides them to the same winter and summer homes. Zoologist Tim Moermond of the University of Wisconsin-Madison says they take directional cues from the environment. And different birds use these cues in different ways.

Moermond says birds may navigate by using landmarks or the positions of the sun and stars. They may even tell where they are by sensing changes in barometric pressure, wind direction and odors. But Moermond says when these cues are absent or weak, birds rely on the Earth's magnetic field to tell north from south.

Many researchers have verified this phenomenon. In one experiment, scientists put magnets around the necks of test birds. They hoped this would interfere with the birds' detection of magnetic force—and the birds *did* become disoriented.

Moermond says birds may also use the magnetic field combined with other directional cues.

> *Birds at night use the magnetic field to set up how to tell where the stars are. They tell the direction they need to go by the magnetic field, but rather than just trying to constantly follow that, they can check which stars correspond to those directions and then use the stars.*

Moermond says researchers don't know yet *how* birds detect the magnetic field. But they have a clue. Several years ago they found a magnetic material called magnetite in the heads of pigeons. Some think this is part of a sense organ that helps birds find their way home in the spring.

■ ***March 1985***

Eulogy for Orange Band

The sun set on another endangered species recently with the death of Orange Band. He was the last of his breed.

The extinction of plant and animal species is often an abstract concept. Scientists and the media constantly warn of threats to rare plants and unfamiliar animals in far-off jungles. But to most of us, extinction rarely strikes home.

That's not the case for a team of biologists at Discovery Island Zoological Park in Florida's Walt Disney World. On Tuesday, June 16th, 1987, they witnessed extinction firsthand. Orange Band, the world's last dusky seaside sparrow, died of natural causes at the age of 12. With him passed the secrets of countless generations of little brown birds that once filled the coastal marshes of Florida.

Discovery Island biologist Charles Cook says Orange Band's death came as a blow to the scientists who had worked for years to preserve his kind.

> *The people who had worked with the bird, of course, are saddened by the realization that an extinction has occurred. The last of a true wild creation is gone.*

But though the last dusky is gone, Cook says the little bird's genes are still viable, thanks to some modern genetics. Scientists have preserved much of the dusky's genetic material through breeding. The last captive duskys were bred with close relatives, Scot's seaside sparrows. Cook says the Discovery Island zoo has a complete set of the dusky's male and female genetic material living in a number of the sparrow hybrids. One female bird is 87.5 percent dusky and looks virtually identical to a purebred. Cook and other scientists hope they can breed a colony of these hybrids and pass on at least a portion of the heritage of Orange Band and his fellow dusky seaside sparrows.

- ***July 1987***

Protecting "Our" Birds

As fall progresses in the upper Midwest, many of the region's birds will take wing for warmer parts. It's easy to think of these migratory creatures as "our" birds. After all, they may be escaping the cold—like tourists on vacation—but they really live *here*.

The notion that these birds belong to our region is now being challenged. Ornithologists point out that nearly half the species that breed in the North spend only about 10 weeks building a nest and raising their young before heading south once more.

More than half of our land birds live most of the year in Mexico, the Bahamas, Cuba and other Caribbean islands. There they occupy smaller land areas and must change their habits. For example, some species that are very territorial and independent up north concentrate in large flocks in the south.

Some birds also change their food sources. The eastern kingbird, for example, switches from insects to the fruits of certain trees. In scattering the seeds, it propagates new trees.

Despite the adaptability of migratory birds, ornithologists worry about the steady loss of winter habitat. The forests that small land birds depend upon in Central America and the Caribbean are disappearing. Scientists say the loss of one acre of this habitat in Mexico has the same effect on bird populations as the loss of eight acres of natural habitat in the northeastern United States and Canada.

Wildlife advocates admit it won't be easy to develop conservation programs with Central American countries that are beset by urgent economic problems. But they say it is essential if we are to preserve "our" North American birds.

- ***September 1982***

■ A Seabird Sanctuary

In Florida, dead or dying brown pelicans dangle from coastal mangrove trees. On some beaches, sea birds hobble about—crippled by broken wings or sick from infected wounds.

These grim sights do not appear in Florida's travel brochures, but they are a tragic result of the state's popular shore fishing. While floating under piers and bridges, many brown pelicans become entangled in fishing hooks and lines. Others actually dive at lures and baited hooks, mistaking them for fish.

Too often, fishermen then cut their lines, believing they are freeing snagged birds. Unfortunately, the tough, long-lasting monofilament line may entangle a bird's wing. If the bird does get airborne, the weighted line may swing in circles, winding around the bird's body or legs. Eventually, the line may catch on a tree, and the bird may die by hanging.

Since 1971, the Suncoast Seabird Sanctuary near St. Petersburg, Florida, has treated more than 10,000 seabirds. The staff now includes 12 veterinarians who donate their services. Most of the feathery patients are brought to the sanctuary by people. In one of nature's mysteries, a few wounded pelicans fly or walk into the sanctuary every week—even birds that have never been treated at the facility before.

Most of the birds survive. Those permanently crippled either stay in the open-air sanctuary or go to a protected park. Many of the grounded birds do their part by mating and producing offspring.

Despite such measures, the brown pelican is an endangered species. With the support of several oil companies, the Suncoast Seabird Sanctuary is using radio, TV and posters to show fishermen how to share Florida's bridges and piers with its trusting native birds. ■ ***July 1982***

■ Migrating "Cans"

V-shaped patterns will soon fill the Midwestern sky as ducks and geese head south for the winter. But many of these birds are having to reroute their flight paths and change their resting spots as people alter the environment.

Canvasback ducks, for example, commonly called "cans," once migrated along the lower Fox and Illinois rivers. Eighteenth century French explorers wrote that waterfowl "blackened the sky" above the lakes of the Winnebago chain in Wisconsin. That heavy migration of ducks—about three-fourths of the world's canvasback population—is seen now over the upper Mississippi River.

Why did the "cans" change course? Biologists point to declining water quality in the Illinois River and the Winnebago-area lakes. Pollution, sedimentation and turbidity have killed many of the aquatic plants in these waters, and it is on these plants that the canvasbacks depend.

Ducks stuff themselves with calories during their migratory stops to power their long flight south. The cans' favorite energy foods—wild celery and arrowhead plants—have mostly disappeared from the Illinois River and the Winnebago lakes, so the ducks have shifted their course to the upper Mississippi, where these aquatic plants still abound.

But with so many ducks crowded into one place, disease or an oil spill might devastate the population. And a decline in the Mississippi's vegetation could leave the canvasbacks nowhere else to go.

Biologists say these resting areas need protection. They recommend soil conservation practices to halt sedimentation of the river and wave barriers to prevent shoreline erosion. It is crucial, they say, that these natural waysides be preserved if canvasbacks and other migratory waterfowl are to survive. ■ ***September 1982***

■ Competition from Abroad

Foreign competition is almost as big a headache for some ecologists as it is for American business. But in this case, the fearsome opponents are plants and animals brought to the United States from abroad—sometimes intentionally, sometimes by accident. And the victims are native plants and animals that just can't keep up.

Becky Brown is an ecologist at the University of Wisconsin-Madison. She says exotics, as they are called, often get a foothold in this country through some sort of ecological disturbance. From there, she says, they can go a couple of different ways.

> *In some cases, the exotics are successful species. If you wait long enough they'll work their way back out of the system and move on to a disturbance somewhere else, and your native species will come back. However, in some cases . . . for instance, the schinus, the Brazilian pepper tree in south Florida, is very well adapted to grow in the very nutrient-poor, thin soils in the pinelands. And so once that species becomes established in the understory of these pines, it is able to out-compete the species that were there before.*

It may not matter to the average person what kinds of plants and animals live in an area. But it makes a big difference to people who are trying to preserve or restore natural wildlands such as prairies and forests. Many ecologists will go to great lengths to get rid of persistent exotics.

Sometimes they prevail. Other times they do not. Once a hearty invader gets established in a new land, halting its spread can be next to impossible. But Brown says it's worth trying where the integrity of a natural area is at stake. And such is the case in more and more natural areas, where disturbances from human activities are opening the doors to foreign competition. ■ ***June 1984***

■ Bring 'Em Back Alive

Kids a couple of generations ago thrilled to the written adventures of Frank Buck. With the proud boast that he would "bring 'em back alive," Buck scoured the remote corners of the world to capture wild animals for zoos and circuses.

But times have changed. Civilization is encroaching upon wilderness areas, dividing them up into ever-smaller patches. Many endangered species live in Third World nations, which understandably focus more attention on meeting human needs than protecting wildlife, so zookeepers—now more concerned with preserving wildlife than exploiting it—have turned to breeding many of their own animals.

Unfortunately, breeding captive animals diminishes genetic diversity. And zoo animals have generally become too domesticated to survive if returned to the wild.

The National Zoo in Washington, D.C., is confronting this dilemma. The zoo opened a Conservation and Research Center in Virginia in 1975. This 4,200-acre facility is devoted to propagating rare and endangered animals. Besides using new animal breeding techniques, the center's veterinarians and biologists are trying to reproduce the diet, habitats and behaviors of the animals in the wild. These efforts are designed to preserve the animals' natural traits and help some of their offspring reestablish the species in protected game parks.

Until recently, zoos had saved only two species from extinction by captive breeding—a Chinese deer and a Mongolian wild pony. But zoos have begun operating more scientifically. Retiring National Zoo director Theodore Reed says zoos will be *the* preserver of endangered species if developing countries cannot stem the continuing loss of wildlife habitat within their borders.

■ ***September 1984***

■ Critter Care

When you see an infant animal in the wild by itself, you may think it needs help. But a wildlife specialist says leave it alone.

As spring approaches and the weather warms, the countryside fills with newborn animals. During spring and early summer, you may see these baby creatures sitting in the wild without a parent in sight. You may think they've been abandoned, but that probably is not the case.

Nancy Frank, director of the Wildlife Animal Rehabilitation Center in Milwaukee, says adult animals frequently leave their infants unattended, but they rarely forget them.

> *Parents, birds especially, don't stay with one individual baby all the time. Once the baby has fledged from the nest, it's on its own during the day. The parents come by and feed the baby, and then they feed its siblings, but then they may be in the next yard or so—they may be quite a ways away from the baby. Generally speaking, though, if you sit and watch, you'll see the parent birds come back.*

Frank says people who think they're helping orphans bring thousands of baby creatures to the Milwaukee wildlife center every year. But many of these animals do not need any help, and Frank says even when an infant animal has been abandoned, the parent probably left it for a reason.

> *The best thing to do is to leave nature alone. Let nature take care of itself. We've often found that when an animal has been abandoned, there's some biological reason for it. Even if we take it in and nurse it, there sometimes is something else wrong that causes its demise, and so it might have been best that we had left that animal alone to begin with.*

Frank says if you must move an infant wild animal, put it in a darkened, padded box to help reduce stress on it, and then take it to a game warden or licensed rehabilitator for treatment.

■ ***February 1988***

■ River Refuge

One of the nation's most heavily used wildlife refuges is close to many cities. But most of the people who visit it don't even know it's there.

The Upper Mississippi River Wild Life and Fish Refuge nestles against the banks of the Mississippi River along a 280-mile stretch from Wabasha, Minnesota, to Rock Island, Illinois. According to Tex Hawkins, it has many unique features.

Hawkins, conservation officer at the refuge, says it is an invaluable wildlife sanctuary, especially for waterfowl. It is a major stopping point on the migration route of the tundra swan, and in the fall nearly three-quarters of the world population of canvasback ducks gathers there. But in addition to abundant wildlife, the upper Mississippi refuge has many *human* visitors.

> *There are over three and a half million visits to the refuge every year, and maybe as many as 10 million people living within easy driving distance. It could get a lot of additional use in the future if the facilities are developed.*

Because the refuge is so spread out and has no major entry point or visitor center, Hawkins says, most visitors are not aware they're in a national wildlife refuge.

> *The majority of people really don't conceive that the refuge exists. They're utilizing it without even knowing it, and that's a dangerous situation. They need to be aware that it's there, that it's special, and it needs protection and care.*

Besides human impact, there's the river itself—one of the major transportation routes through the heart of the nation. The heavy barge traffic can create problems for wildlife, as can the locks and dams needed to keep the traffic flowing.

According to Hawkins, wildlife managers face a difficult task: balancing the needs of people, commerce and nature. ■ ***October 1985***

■ Phoenix from the Ashes

Last summer's fires in Yellowstone were a tragedy to many people. But to others, they were the best thing to happen in a hundred years.

Fire scorched three-quarters of a million acres in Yellowstone National Park last summer. It was the biggest burnoff in the park's history. Many people saw the spectacular blazes as a national disaster and criticized the National Park Service for letting them get out of hand.

But ecologists say the fires were long overdue. Over the next few years, they say, the park will blossom with new wildlife habitat and more animals, and the benefits will be felt well into the next century.

The tourism industry contends that park visitors want their geysers framed by sweeping forests, not charred stumps and fields of fireweed. Yellowstone public affairs officer Joan Anzelmo says the argument pits park ecology against park economy.

> *If you could take the developments out of here and you could take the towns that obviously depend on the tourism flow out of here and just took it purely from a biological standpoint, just purely from the benefits to the ecosystem, there will be long-term benefits to the ecosystem. You know, new habitat has been created by where fires have burned, the animals will benefit in the long run, and fire has been an integral part of this forest for thousands and thousands of years. But again, in 1988 you have many, many things to take into consideration.*

In the wake of last summer's fires, Interior Secretary Donald Hodel announced that the Park Service will fight all future fires in national parks. Ecologists say that's a mistake because fires are natural events that preserve ecological diversity. In the long run, they say, Yellowstone and other parks are better off with an occasional blaze.

■ ***October 1988***

■ Creatures in the Hold

A lot of marine life is stowed away in the holds of modern ships.

When ocean freighters and tankers sail without cargo, they carry ballast to remain stable on the open sea. Wooden sailing ships once carried rocks or sand as ballast. Modern ships use millions of gallons of seawater stored in their holds and ballast tanks. The ships discharge the seawater in harbors before they take on cargo.

James Carlton, a marine ecologist at the University of Oregon, says modern vessels, when they take on ballast water, become giant aquariums filled with marine life. To help determine how seawater stowaways might affect marine environments on the West Coast, Carlton examines organisms he finds in the ballast water of ships that visit Oregon's Coos Bay.

> *We're seeing a surprisingly wide diversity of organisms in the seawater ballast, even more than we expected. We see a lot of truly planktonic organisms—copepods, which are small crustaceans distantly related to the shrimps and crabs; we also see a lot of larval forms, the juvenile stages, of many bottom-dwelling or benthic species including clams, crabs, shrimp, other small crustaceans and snails.*

Carlton says ships full of seawater ballast also can carry new species to freshwater environments. He says ocean vessels that enter the Great Lakes have released juvenile European flounders and Chinese mitten crabs into the lakes. Although the creatures were able to reach maturity, they were unable to reproduce.

Carlton says the use of seawater as ballast has grown since World War II along with the size and number of ocean-going ships. However, the environmental effects of this practice are still undetermined. ■ ***February 1988***

Musseled Out

When European naturalists first explored North America, they reported finding more than a thousand species of clams and mussels in the Mississippi River and its tributaries—an astounding number compared to the handful in the rivers of Europe.

David Heath, curator of mollusks at the University of Wisconsin-Madison Zoology Museum, says little more is known about the biology of these river-dwellers today than when they were discovered. But one thing that *is* known, he says, is that clams and mussels are not as plentiful in the Mississippi as they used to be.

The Higgin's eye mussel—one of the few that have been studied—is a good example. It once ranged from the Twin Cities of Minnesota down to the mouth of the Missouri River. Heath says sewage to the north and sedimentation from farmland erosion to the south have greatly reduced the range and numbers of the Higgin's eye. In fact, the mussel is now included on both the Wisconsin and federal endangered species lists.

Heath says the river's dams also take their toll on the Higgin's eye and its Mississippi River cousins. Tiny young clams and mussels begin life floating downstream until they land on fish and become parasites. Where dams prevent those fish from migrating upstream, the mollusks cannot return to the favorable habitats from which they came. As a result, their species gradually disappear from those stretches of the river.

That's not all. Heath says where dams slow the Mississippi's current, silt settles behind them and can smother clams and mussels on the river bottom. Besides that, the creatures need a steady current to carry food to them, and dams can cut off their food supply.

The Higgin's eye mussel is the only Mississippi River mollusk listed as endangered or threatened. But Heath says that doesn't mean the rest are thriving; it's just that nobody knows for sure how they're doing. ■ ***May 1985***

Sterile Aliens

Scientists are developing a new way to eradicate sea lampreys from the Great Lakes. They are not trying to kill lampreys; they're trying to keep them from being born.

Eels known as sea lampreys entered the Great Lakes years ago through waterways built to allow shipping between the upper lakes and the Atlantic Ocean. During the 1930s and 1940s, sea lampreys devastated populations of lake trout and severely disrupted the ecology of the Great Lakes.

The United States and Canada responded to the lamprey invasion with a chemical, known as TFM, that helped kill young lamprey in streams where the adult parasites spawn. Now scientists are looking at other ways to wipe out lampreys that remain in the Great Lakes and the streams that feed into them.

Sterilizing lampreys is one option. This technique focuses on male lampreys for two reasons, says James Seelye, chief of the U.S. Fish and Wildlife Service office at Hammond Bay, Michigan.

> *Male lampreys are—for one thing—more easily sterilized. And also, we think that in the process of spawning in normal lamprey populations, one male lamprey will service or fertilize more than one female lamprey's eggs, and so it makes more sense to sterilize the males that might actually offset the reproduction of one or two or three female lamprey rather than the other way around.*

Seelye says a promising sterilization method uses a chemical called bisazir. The male lamprey's sperm becomes sterile after the lamprey is immersed in the chemical or injected with it. Seelye says field trials with bisazir may begin in 1989 after government agencies define safety procedures for people who will handle the lampreys and the chemical. ■ ***July 1987***

■ The Fear of Cod

A marine scientist instilled the fear of cod in some naive salmon to teach the fish of worldly dangers.

Fish raised in hatcheries have easy lives. Before they're released into open water, they do not have to search for food or worry about predators. But hatcheries may be artificially safe environments that do not prepare fish for the dangers of the real world.

Bori Olla, professor of oceanography at Oregon State University and a researcher with the National Marine Fisheries Service, is studying the survival of young fish in the Pacific Ocean. Olla says that of all hatchery-raised salmon released in the Pacific Northwest, only about 5 percent survive. He says hatchery-raised salmon quickly learn to search for live prey, so they apparently do not starve to death. But the young salmon may be dangerously naive about predators.

Olla gave some hatchery-raised salmon a safe but scary exposure to a voracious species of cod. He wanted to see if a brush with reality would help the salmon survive direct encounters with predators. He put a clear plastic corral inside a larger pool and then put 30 young salmon inside the corral and two lingcod outside it. When he turned on the lights, the lingcod responded enthusiastically.

> *As soon as we switched on the lights, the predators—the two lingcod—saw the salmon behind the Plexiglas and immediately attempted to get in at them, and they'd bang against the Plexiglas, frightening the fish and attempting to eat them.*

Olla and other researchers then scared the salmon even more. They dropped a frozen cod in their midst and disturbed water inside the corral. Salmon that endured two of these controlled encounters were more likely to survive a third direct encounter with the lingcod. Olla says fish in hatcheries may need this kind of brush with reality if they are to survive after they're released into open water. ■ ***April 1987***

■ A Taste for Junk Food

The shark family includes the largest of fish and the most feared. But some scientists know the shark to be more of a garbage disposal than a man-eater.

Sharks have a reputation—fed by popular books and films—for unprovoked attacks on humans. But very little is actually known about the feeding habits of sharks. Although they prefer certain foods, a remarkable variety of items has been found in the bellies of sharks throughout the world.

Stomachs of sharks have revealed a potpourri of garbage indicative of less-than-discriminating palates: beer bottles, a handbag, paper cups, orange peels, nearly an entire reindeer and even five bottles of mineral water bound together with a wire hoop. One shark alone had swallowed a raincoat, three overcoats and a car license plate.

Of the 350 species of shark, only two dozen eat mammals. But these sharks are not selective either. A goat, a turtle, a large tomcat, three birds, four fish heads and another shark—six feet long—were taken from the stomach of one shark caught along the Australian coast.

John McCosker, director of San Francisco's Steinhart Aquarium and an expert on great white sharks, says fear of sharks stems from ignorance and propaganda. He explains why great whites may inadvertently attack humans.

> *This is the largest of flesh-eating sharks, and its normal diet is large seals and sea lions as well as dolphins. We humans do our very best to imitate the behavior of seals and sea lions when we put on our black wetsuits or lie upon our surfboards floating at the surface, and the shark confuses us for its normal prey.*

McCosker says there are no accurate records on shark-attack fatalities throughout the world, and scientists still do not know for sure what provokes sharks to attack humans. But he agrees with most experts: There's no telling *what* a shark will eat. ■ ***September 1986***

■ Pondering the Ponderous

Scientists in New Mexico have made an earth-shaking discovery: They've found the remains of the biggest creature known to have walked on land.

Imagine an animal bigger than a dozen full-grown African elephants. That's how David Gillette describes the 150-million-year-old dinosaur remains he's excavating in northwestern New Mexico.

Gillette, curator of paleontology at the New Mexico Museum of Natural History, named the discovery *seismosaurus*, or "earth shaker." He says the 100-ton dinosaur stood two stories tall at the shoulder and stretched 120 feet from nose to tail. *Seismosaurus* was easily the biggest known land-dwelling creature. Gillette speculates that this plant-eater evolved to great size so it could fight off attacks by allosaurs, relatives of the well-known tyrannosaurs.

> *And allosaurus, as the dominant predator of the time, was probably an ambush power predator that would bowl over its prey. Now, an adult allosaur would weigh on the order of three to four tons. With that much weight behind them, it's to an animal's advantage to have weight to protect themselves.*

That kind of weight had its problems, too. Gillette says if seismosaurs stumbled, their joints could have snapped under the strain of their shifting weight. They were probably confined to flat, forested land where they could easily keep their balance and find protection from the hot sun. Gillette says the beasts probably lived in lush river valleys much like the area along today's lower Mississippi River.

So far, Gillette and his crew have dug out a long section of the dinosaur's tail and part of a leg. Depending on how much of the skeleton lies under the New Mexico desert, he says, it may take 10 years to recover the rest. ■ ***September 1986***

■ Tailing a Tale

Mythical beasts are hard to catch. But one group of scientists is sure trying.

Around the world, tales abound of mythical creatures: the Loch Ness monster, bigfoot and the abominable snowman. Most people are skeptical about the actual existence of such creatures, but scientists at the International Society of Cryptozoology take them seriously. The society, based in Tucson, Arizona, is a clearing-house for information on creatures known in folklore but not in science.

Do not scoff. There *are* modern examples of supposedly mythical creatures that in fact exist. For instance, African natives once described a huge, hairy, man-like creature that roared and lived in trees. Western scientists wrote off these reports as superstition until 1901, when the mountain gorilla was first seen by a British explorer. Then there is the coelacanth, a fish discovered in the Indian Ocean in 1938. It was presumed extinct for millions of years.

International Society of Cryptozoology secretary Richard Greenwell urges people to keep an open mind about creatures of legend.

> *One cannot ignore anecdotal information or information coming from what we generally refer to as native peoples who report things that science isn't aware of, or if it's aware of it, doesn't accept. There still are a lot of remote areas that zoologists don't get to, and we should continue trying to uncover such information in the future.*

Recently, researchers affiliated with the society have investigated a legendary large cat in Mexico, a dinosaur-like creature in central Africa and a human-like beast known as bigfoot in the Pacific Northwest. ■ ***March 1988***

Evolving Knowledge

In the minds of scientists, the concept of evolution is itself still evolving.

Many scientists no longer picture evolution as a process of slow, gradual change. Geologist Peter Sheehan of the Milwaukee Public Museum says it happens in bursts.

> *In reality, there is a much more punctuated style to evolution; that is, evolution often occurs over very short periods of time, and we go through long intervals of time where there's not much going on evolutionarily.*

By very short periods, Sheehan means a few million years. That's brief, given the Earth's five-billion-year age.

Sheehan says bursts of evolution happen after sudden and widespread extinctions of plants and animals. Whatever the cause, extinctions lead to an evolutionary battle between surviving organisms for the food and shelter the extinct species leave behind. The survivors change rapidly to assume new roles. And once they divide up the available resources, stability sets in until some event causes another round of extinctions.

That pattern has occurred time and again. The best-known example follows the disappearance of the dinosaurs. They went from domination to nonexistence in less than a million years. The dinosaurs' demise caused a massive ecological reorganization, and mammals came out on top.

Sheehan says the rise of mammals shows how quickly organisms can evolve. During the reign of the dinosaurs, most mammals were tiny creatures that lived in rotting stumps and dined on grubs and insects. They took what they could get. That went on for a hundred million years, but as soon as the dinosaurs died out, mammals burst forth in shapes and sizes to fill the roles that once belonged to their reptilian rivals. Things have been relatively stable ever since. ■ ***December 1987***

Count the Bites

Most people would do just about anything to ward off mosquitos. That's not true of William Hilsenhoff. He actually waits for mosquitos to bite him.

Hilsenhoff is an entomologist at the University of Wisconsin-Madison. He has been known, on occasion, to submit himself to a biting count.

On those occasions, Hilsenhoff bares his arm or his back to ravenous mosquitos while an assistant notes the kinds and numbers of species that accept the offer. It's not the most pleasant way to spend an afternoon, but Hilsenhoff says it can reveal a lot.

> *The studies done on mosquitos have shown that certain species feed on people and other mammals. Other species feed on birds. There are even a few species that feed exclusively on reptiles and amphibians. The great majority probably feed on mammals, and so from studies that have been done and from biting counts, we know which species are really bothersome to people.*

Based on these biting counts, Hilsenhoff has found that only three or four of Wisconsin's 50 species of mosquitos bother people. One of these, *Aedes vexans*, lays its eggs in temporary pools that are flooded in late spring and summer. A single square-foot puddle in one of these areas can produce as many as 100 mosquitos a day.

Some mosquitos can carry serious diseases like malaria and encephalitis. But Hilsenhoff says the threat from mosquito-borne diseases is very low in the United States. The insects are more of a nuisance here than anything else. Unfortunately, attempts to reduce their populations are usually costly or ineffective, so Hilsenhoff recommends a good mosquito repellant against the voracious little bugs. ■ ***June 1982***

■ The Mosquito Hawk

While wandering along a lake or stream, some of us may flinch as a dragonfly darts across our path. Its menacing nicknames—"horse stinger" and "devil's darning needle"—do little to relieve nervous regard for this shimmering-blue, double-winged aerial acrobat.

But we have nothing to fear and much to appreciate in the dragonfly. According to Michigan's Audubon Society, the flying insect is harmless to people, but true to its other moniker—the "mosquito hawk"—the dragonfly voraciously hunts down mosquitos, flies and other winged insects. In fact, a town in Maine imports thousands of dragonflies every year to control mosquitos.

The dragonfly's most prominent feature is the pair of bulging eyes that occupy almost its entire head. The lens of each eye has more than 30,000 facets. As its head swivels freely on its neck, the dragonfly easily detects movements 120 feet away. All this makes it a ruthlessly efficient predator of mosquitos and such agile insects as gnats and midges.

Other notable features of the dragonfly are two pairs of nearly transparent wings that are outstretched even at rest. The wings appear fragile but are strongly braced with a network of tiny struts. A complex set of muscles controls the wings, enabling the dragonfly to hover and then veer off at speeds up to 30 miles an hour. In these flights, its feet—curled forward to form a basket under its body—scoop up mosquitos and other prey.

So when you spy a dragonfly darting your way this summer, you should not flinch. Contrary to folk lore, the devil's darning needle is not going to stitch up your ears. It's more intent on snapping up mosquitos, and it should be honored as one of our greatest friends. ■ ***August 1984***

■ Nature's Pesticides

Insects eat almost half of the world's agricultural crops. And although scientists continue to add new weapons to their pesticide arsenals, victories against crop pests are usually short-lived.

Scientists, however, have taken a new tack in their battle against crop-eating insects. They have discovered natural agents such as fungi, bacteria and viruses that all help control crop pests.

In some countries, insecticides consisting of fungi are widely used to combat pests that attack crops like apples and corn. Mallory Boush, a University of Wisconsin-Madison entomologist, says certain species of fungi act as biological pesticides by attacking and killing insects. He says fungal spores attach themselves to insects and work their way into the bugs' bodies.

> *The spore germinates on the outer wall or integument of the insect and, through enzymatic action, actually breaks down this outer wall, and then the fungal development takes place within the body of the insect.*

Boush says fungi have some clear advantages over conventional insecticides. For example, they are natural agents that do not pollute the environment. Unlike chemical pesticides, fungi are host-specific, meaning they attack just one or two kinds of pests. This selectivity prevents the killing of beneficial insects like lady bugs that also prey on insect pests.

Although fungi show promise, they are not problem-free. Boush says weather conditions such as humidity and temperature must be just right for the fungal spores to germinate and grow on insects. But scientific study continues, and some day fungal insecticides may be commonly used to protect valuable crops. ■ ***March 1984***

■ No Picnic

A tiny insect from South America is making life miserable for people in the southern United States.

Since stowing away on ships from Brazil in the 1930s, red fire ants have infested nine southern states. And despite the best efforts of science, they continue to spread.

Entomologist Ann Sorenson of the Texas Department of Agriculture in Austin has studied fire ants for seven years. She says they've earned their name.

> *They're a very aggressive ant. They will readily defend their mound, they will readily sting, and they can sting repeatedly. And their sting causes a fiery sensation.*

Sorenson says for most people, fire-ant stings are a painful nuisance. But for a few, they cause a dangerous allergic reaction. Fire ants are bad news for farmers, too. Sorenson says they can harm citrus and soybean crops and are said to have stung newborn calves to death. Besides that, their hardened mounds, often three feet tall, have damaged farm machinery.

Fire ants naturally spread up to 15 miles each year, and Sorenson says they can travel much farther by hitching rides on trucks. To control the problem, Texas restricts the transport of nursery plants and sod and encourages pesticide use for local infestations. But Sorenson says getting rid of fire ants isn't likely soon.

> *It would be next to impossible for us right now to eradicate this ant, based on what we know about it. What we are trying to do is to bring it under control, to get people temporary relief where there are heavily infested areas.*

Sorenson says scientists are studying how fire ants reproduce and search for food in hopes of finding a natural way to rid the South of the imported pest. ■ ***October 1985***

■ Leave it to Beavers

For six years, beavers out West have been working with the federal government on several critical soil erosion projects. The collaboration between nature's buck-toothed construction engineers and the Bureau of Land Management is reducing the loss of land and stream-side meadows in southwest Wyoming.

Since 1900, about 80 percent of these valuable lands in Wyoming have been destroyed by erosion. The problem started with herds of cattle munching away the willows, aspens and poplars alongside the streams. When these trees disappeared, beavers no longer had the materials to build their dams and lodges. Without beaver dams to slow the currents, the streams became ever-deepening gullies.

But in 1977, a Bureau of Land Management biologist saw beavers struggling to build flimsy dams using sagebrush—the only material available. It occurred to him that with a little help, the beavers could control erosion better and certainly at less expense than the government.

And so the feds bought some cut-down willows, aspens and poplars and gave them to the beavers. Critics saw the project as simply a welfare program for the animals. But the eager beavers held up their end of the bargain, building and maintaining a series of effective river impoundments.

On one five-mile stretch, soil erosion dropped from 109 tons a day to just four tons. On another once-barren shoreline, vegetation now extends 30 to 40 feet inland from the bank. And the entire beaver dam project has cost less than $6,000.

Success has apparently made beavers and bureaucrats into partners. This fall, they've extended their enterprise to eroding streams in northern Utah. ■ ***November 1983***

■ A Break for Bats

A conservation group says bats have gotten a bad rap.

Bats are not vicious, they rarely transmit rabies, and they do not entangle themselves in people's hair. But myths about bats persist.

Bat Conservation International (BCI) hopes to change that. The Austin, Texas-based group is working to preserve bat habitat and to educate the public about the vital role bats play in ecology. BCI ecologist Paul Robertson says, for example, that the growth and productivity of tropical forests depend on bats.

> *Bats in tropical areas are extremely important as pollinators of plants of many different types, and they also are very important seed dispersers.*

Robertson says most of the 39 bat species in the United States serve a different but equally important function.

> *They eat prodigious amounts of insects. Each species seems to have a different sort of palate for insects: Some prefer one form of insect, some prefer another form. But in general they're extremely valuable in just controlling insect populations.*

Robertson says many of the insects that bats eat are crop pests and mosquitos. The most spectacular bug hunters fly out of a cave north of San Antonio, Texas.

> *Every night those bats go out on a feeding foray. Twenty million bats—it takes two hours for them just to get out of the cave. They go out on a feeding foray, and during that time, a conservative estimate of what they eat is one-quarter of a million pounds of insects a night.*

Robertson often takes college students to stand at the entrance of the cave as the Mexican free-tail bats rush by. He hopes people will get over their fear of bats. He says a change of attitude would help protect bat habitat from development, vandalism and other threats. ■ ***August 1987***

■ Bear Facts

Go to the zoo on a summer day and you'll probably see people tossing marshmallows to docile bears. There's little indication of the strength, intelligence and wildness of these magnificent omnivores.

In the wild, bears are solitary, wary of people and most active at night. They are also unpredictable in their encounters with humans.

Black bears and grizzly bears are the only two species that live in the lower 48 states. Black bears are, by far, the more widespread and abundant. Despite their name, they are often brown, cinnamon, even blond. From tiny cubs weighing just a few ounces at birth, they grow into muscular adults of several hundred pounds. Upright on their short, stocky legs, they stand about six feet tall. In spite of their bulk, they are excellent tree-climbers. And apart from man, they have no natural enemies, though they will always yield to the larger grizzlies when the two meet.

As many campers know, black bears eat almost anything. They have strong jaws with both long, pointed canine teeth and flat molars enabling them to eat a wide variety of vegetable and animal foods. Although they can reach speeds of 25 miles an hour when chasing prey, they are generally too slow to catch deer, elk or moose, so they settle mostly for nuts, berries, honey and small animals.

Black bears once lived throughout North America. Over time, civilization and hunting have reduced their range. But unlike their cousins the grizzlies, who seem to need true wilderness to survive, black bears have shown an uncanny ability to adapt. There are still an estimated 150,000 of them in this country, and they continue to thrive in all but a dozen states. ■ ***August 1982***

■ Caring Killers

Killer whales are hunters with impressive credentials. They grow up to 30 feet long and weigh as much as nine tons. They have more than four dozen razor-sharp teeth. Even their name is sobering.

But those who know them say killer whales have another side that dispels their nasty image.

Researchers at the Moclips Cetological Society in Friday Harbor, Washington, have studied the animals' social life. Their results show that these largest members of the dolphin family are not wanton killers. Rather, they are intelligent mammals with strong family ties.

Killer whales, also called orcas, live in close family groups known as pods. Pods range from 10 to 50 animals and stay together year-round. The members hunt, play and care for the young together. Richard Osborne, a biologist with the Moclips Cetological Society, says some whales even specialize in child-rearing.

> *We have females that are closely associated with mothers, who have never given birth to calves themselves but always seem to take care of the next-oldest calf every time a certain mother gives birth to a new whale.*

Osborne says these female whales, called "aunties," don't always baby-sit alone. Sometimes the males take over.

Part of the reason orcas can maintain such a complex social life is their skill at communicating. They use a system of clicks and whistles to communicate between pod members and between the pods themselves. Moclips scientists have discovered that each region, and even each pod, has a distinct dialect. This enables individuals to recognize pod members and helps different pods identify each other.

Unlike some whale species, orcas have a healthy world population. And the work of scientists on the Washington coast is helping it stay that way. ■ ***February 1984***

■ Look Out for Swimming Elephants

Boaters and swimmers enjoying Florida's warm coastal waters may be surprised to see a large creature swimming near the water's surface. It looks like a walrus without tusks, but it's not. It's a West Indian manatee.

This marine mammal shares a common ancestry not with the walrus or seal but with the elephant. Although it has no trunk, the manatee's leathery hide, sparse hairs and fingernails on the flippers do resemble characteristics of the elephant. Its size is elephantine as well. It can grow up to 15 feet long and three feet high and weigh as much as a ton.

About a thousand manatees inhabit the coastal and inland rivers of Florida. Although 17 sanctuaries exist there to protect them, manatees are still in danger. These shy marine mammals have no form of defense, including defense against people. Because they have to surface for air, they often swim in shallow water where they get hit by speeding motor boats. This can inflict serious injuries.

According to University of Florida wildlife specialist Margaret Kinnaird, propeller scars have become a manatee's identification tag. Kinnaird is studying boat-related manatee injuries and deaths. She hopes to find those areas in the sanctuaries where injuries occur most often. Then manatee warning signs can be installed and boat traffic slowed or even prohibited.

Kinnaird says many swimmers and boaters don't know that manatees exist and are alarmed to see them in the water. She stresses that public awareness and good sanctuary management are vital in protecting these gentle giants. ■ ***May 1983***

■ Gorilla Welfare

A bright idea has saved an endangered species of gorilla from almost certain extinction in Africa.

Only about 300 mountain gorillas remain, isolated in a small parcel of rain forest in east-central Africa. Amy Vedder, a graduate student in zoology at the University of Wisconsin-Madison, has studied the gorillas in Volcanos National Park in Rwanda for the World Wildlife Fund. She says their low numbers and limited range make them especially prone to extinction.

> *They can't live in any old forest, and along with the fact that they reproduce very slowly, they develop slowly, they have restricted distribution. That means they are a species that's vulnerable to problems of extinction. If something else drives them to small population sizes, they're very vulnerable to becoming extinct.*

When Vedder began her studies in Rwanda, it looked as though the mountain gorillas were doomed. She discovered that poachers were killing many of the animals for their skulls, which they sold as curios. Worse still, the Rwandan government was planning to clear almost half the rain forest in the national park to raise cattle.

But Vedder and her husband, Bill Weber, who also works for the World Wildlife Fund, helped change all that. They persuaded the government to promote the mountain gorillas as a tourist attraction. Weber organized daily tours to take visitors to see the gorillas in the wild. He also trained a regiment of park rangers to scout out snares and clamp down on poachers.

Now, says Weber, gorilla poaching is down in Rwanda. The country has dropped the cattle ranching scheme because of a 12-fold increase in money spent by visitors to Volcanos National Park, and there's new hope for the mountain gorillas' survival. ■ ***February 1985***

■ Old King Clone

The Mojave Desert northeast of Los Angeles is not one of the world's most hospitable places. But King Clone, possibly the oldest living thing on earth, seems to like it.

Ten thousand years ago, when the last ice age was ending, King Clone was already an old-timer by human standards. Now, at the ripe age of 11,700 years, King Clone—a creosote bush—claims the title of the oldest living thing on Earth.

For many years, scientists believed that the oldest living organism was a bristlecone pine in California, dated at nearly 5,000 years of age. But then the researchers started looking at creosote bushes—low, nondescript shrubs common in deserts throughout the southwest.

Creosote bushes grow by cloning, beginning from a single seed. Each successive layer of low branches develops roots on its own. Over time, the bush spreads out into a ring, with a circle of bare ground in the center. While a creosote bush may look like a series of unconnected plants, genetically it is one individual and functions as does a single plant.

Using sophisticated techniques like radioactive carbon dating, scientists are able to estimate the rate at which the circle of a creosote bush expands. Then, by measuring the distance from the outer edge of the plant to the middle of the ring, they can compute the age.

Creosote bushes with diameters of 30 feet or more are relatively common in the Mojave Desert. But the bush nicknamed King Clone is 70 feet across, making it close to 12,000 years old.

By studying very old creosote bushes, scientists hope to learn about the origins of the Mojave Desert. Old King Clone will be around a while longer for such research, thanks to the Nature Conservancy. The private conservation group bought the surrounding land because less than a mile away, new houses are springing up. ■ ***May 1985***

■ The Tree that Started a War

If not for the white pine tree, the United States of America might never have been. Take a look at colonial history and you'll see why.

The stately pines once dominated America's northern forests. They were so abundant in New England that early settlers spent much of their time just clearing pine trees off the land so they could farm. As far as the settlers were concerned, white pines were almost a nuisance.

England, on the other hand, considered the trees quite valuable. Their tall, straight, lightweight trunks made ideal masts for sailing ships, so England passed conservation laws to protect the trees.

That set the stage for conflict, as Wisconsin naturalist Wayne Pauly explains.

> *By 1700, England had lost virtually all its forests, so they knew what could happen. They sent foresters over here to mark trees with the king's broad arrow, and that meant it belonged to the king. Well, pioneers being pioneers, they cut the trees down anyway. So England sent spies over here. Well, spies caught the men, but American judges, juries and sheriffs wouldn't arrest, try or convict a man for cutting down a tree. I mean, that's silly! So England decided to take these men over to Europe for trial. Now we're getting into the 1760s, 1770s. We're talking about a hundred years of controversy over the white pine trees. So that's why the Revolution really started in the New England states to some extent, because the white pine tree was an economic and psychological reason.*

Pauly says colonial settlers got mad just *looking* at white pine trees, mad enough to go to war, and during the Revolution they carried battle flags whose designs included the white pine as a symbol of their anger and determination.

■ ***September 1982***

■ Autumn Kaleidoscope

Glorious golds. Picturesque purples. Resilient reds. The greenery of summer bursts into a kaleidoscope of color during clear, crisp autumn days.

Fall foliage can be spectacular. But have you ever wondered what causes the dramatic change?

Throughout the summer, trees produce food through photosynthesis. Chlorophyll, the substance that gives leaves their green color, captures the sun's energy to power the process. The cooler temperatures and shorter days of early fall cause trees to slow down. They use up their chlorophyll, and the green tint of the leaves fades.

Yellows and oranges once hidden by chlorophyll now show through. Elm, birch and poplar are just a few of the trees that light up like gold.

Maples and red oaks, meanwhile, flame with scarlet and purple. As these trees slow down for the winter, sugars get trapped in their leaves and sunlight turns the sugars to a red dye. The more sugar in a leaf, the darker the red.

The timing of the color change depends on the kind of tree, its location and the weather. Gordon Cunningham, a University of Wisconsin-Extension forestry professor, says a sunny, dry, cool autumn usually gives the most brilliant display. The brightest foliage peaks in the north around mid-September; then this kaleidoscope of colors rolls southward through October. ■ ***September 1982***

■ Better to Light than Fight?

Fires sweep through the foothills of southern California with alarming frequency. Each fire seems more devastating than the last. People say California's chaparral, a forest of stunted trees and brush, seems almost designed to burn.

The critical time is fall, when the hot, dry Santa Ana winds and low humidity combine to make the chaparral extremely flammable. A single bolt of lightning, a bit of human carelessness or an arsonist's match can set it ablaze. And once a chaparral fire begins, there is little anyone can do to keep it from roaring off on a destructive rampage.

Tom Bonnicksen is a forestry professor at the University of Wisconsin-Madison who has studied chaparral wildfires. He contends they are inevitable and says conventional attempts to put them out can be counterproductive.

> *Here we have a situation where we can't prevent ignitions from occurring. We can't stop lightning, can't stop accidents, can't stop the deviant individual. If you did succeed in putting out most of the fires, the fuels would gradually accumulate to the point where they would inevitably burn again.*

Bonnicksen says suppressing wildfires allows a buildup of dead limbs and other plant material, and that only assures the *next* fires will be larger, hotter and more intense.

Instead of just fighting chaparral fires, he says, it would be wiser to burn patches of brush deliberately from time to time under controlled conditions. That would reduce the chances of wildfires raging over large areas later. And according to Bonnicksen, controlled burning would cost a lot less than conventional fire fighting.

In other words, it may be better to light than fight. ■ ***October 1982***

■ Now That's a Big Tree

They come armed and ready to bag their quarry. They're the big-tree hunters, tape measures in hand.

If you spot a group of people sizing up that giant oak tree in your front yard, don't panic. They may be looking for a new champion for the American Forestry Association's National Register of Big Trees.

The private association, based in Washington, D.C., is looking for the biggest individual in each of 850 tree species growing wild in the United States. To become a champion, a tree must be the tallest and have the largest girth and widest crown of any of its kind. New champions are not easy to find. Some record-holding trees have reigned since 1940, when the American Forestry Association established the register.

Deborah Gangloff, director of the National Register of Big Trees, says honoring the leafy giants encourages appreciation of trees in general.

> *It's basically a promotional program to communicate the benefits of all trees everywhere to people by focusing on those of unusual size. It's sort of a Ripley's Believe It Or Not of trees. And our main point is to get people out there learning about trees, learning how they're measured, and learning to identify them, which is the number one step.*

Gangloff says the program helps students from grade school to graduate school identify trees. She says everyone can get involved.

> *The big-tree hunters we rely on are just people interested in trees: They're not necessarily professional foresters. They spend their time looking around the forest for the giant trees, and then they send me a nomination.*

The American Forestry Association publishes the locations of champion trees every four years. Landowners often designate them with a plaque. Only Alaska, Wyoming and Nebraska have yet to locate a champion within their borders.

■ ***November 1988***

■ Bush League Defense

It's tall, green, and so mean that the U.S. Marine Corps nicknamed it P.T.—short for pain and terror.

Its scientific name is trifoliate orange, and it's a bush that grows wild throughout Tennessee. A member of the citrus family, it makes a tall, handsome hedgerow. Glossy green leaves cover the bush from March to October. Pretty white flowers bloom in the spring.

But the plant's good looks cannot hide its aggressive personality. Mike Pardon is marketing manager for Barrier Concepts, Inc., of Oak Ridge, Tennessee. He says when planted as a hedgerow, trifoliate orange creates a formidable barrier against trespassers. It is, he says, one vicious-looking bush.

> *The thorns range anywhere from one inch up to five inches long. And it's a very dense mass of limbs all intertwined together. So it's impossible to get through.*

Pardon's company markets trifoliate orange as a product called the Living Security Fence, and the U.S. armed forces are among its most enthusiastic fans. The Marine Corps calls it P.T.—as in pain and terror. Pardon says the thorny wall gives would-be intruders second thoughts.

> *Most people can go across a chain-link fence in about three seconds, and it may take them an hour or half an hour to even think about a way to go across a hedgerow like this.*

Government agencies are not the only ones planting P.T. Pardon says suburbanites as far north as Grand Rapids, Michigan, have invested in living security fences. So don't be surprised if one day you find your neighbor posting a sign with this ominous warning: "Beware of Hedge."

■ ***December 1988***

■ Distress Signals

When they're thirsty, plants call for help. But who hears them?

That house plant in your window may be screaming out for water. You cannot hear it, but it's possible that insects can.

When plants dry out, vein-like tubes inside them snap and let out high-pitched chirping sounds. A plant may chirp for up to six weeks before it dies of thirst. These distress calls are too high-pitched for people to hear. But special recording equipment can capture the sounds in a laboratory. That allows scientists like Robert Haack to study them.

Haack is an entomologist with the U.S. Department of Agriculture. He believes some insects may home in on the distress signals of plants. Haack says thirsty plants are a good find for many insects. Plants under stress cannot defend themselves against attack as well as healthy plants. Drought-stricken plants are also richer in sugars and nitrogen, so they make for better eating. And many wood-burrowing insects prefer to lay their eggs in weakened plants.

Haack explains that plants do more than chirp frantically when they're under stress. They actually run the equivalent of a plant fever, and they give off a different odor than usual. Insects may look for a combination of these signals to find a meal.

> *It could turn out that it's just one more plant cue that the insects use. So they may use their eyes, their noses and their powers of taste. But they also may use their sense of touch or sense of hearing to pick up these vibrational cues.*

Haack says it's not yet clear whether insects actually hear when a plant is in trouble. But there is one clue in favor of his theory: He says insects rarely land on thirsty plants unless the distress calls have started. ■ ***December 1988***

3: The Land

Wolfgang Hoffmann

■ New Roots

You may not dine on curly-dock pancakes or gamma grass on the cob anytime soon. But a Kansas plant geneticist hopes these and other prairie plants will one day replace corn, wheat and soybeans in America's farm fields.

Wesley Jackson, director of the privately operated Land Institute in Salina, Kansas, is trying to develop perennial crops that would not have to be plowed under and replanted every year. He says this would save energy and protect soil from erosion. And he says several native plant varieties are higher in nutritional value than many of today's crops.

According to Jackson, plants like eastern gamma grass, a high-protein relative of corn, take nitrogen from the air to make their own fertilizer. Others, such as Maximillian sunflowers, produce natural pesticides. Jackson thinks several varieties could be planted together in a field to share their beneficial characteristics and reduce the need for synthetic fertilizers and pesticides.

Critics claim these kinds of plants cannot meet the demands of the modern agricultural market. They say it isn't possible to get a high seed-yield out of perennials because the plants need to reserve their energy for the next year's growth. So only annual plants, like corn and wheat, can afford to put most of their energy into seed production.

But Jackson disagrees. He points out that plants like curly-dock, a member of the buckwheat family, are more productive than many common farm crops. He says by breeding them for certain characteristics, scientists could make other prairie perennials more productive as well.

Jackson says change will come slowly. He hopes to persuade some farmers to grow his prairie plants on land easily eroded by row crops. He believes these farmers would save soil and energy and still get a good return on their investment.

■ ***April 1985***

■ Plant Partnerships

Next to weeding, the biggest headache for home gardeners is protecting vegetables from insects and other animal pests.

Lawn and garden centers usually prescribe chemicals to get rid of pests, but many people prefer not to use them. Instead, they try a rather old-fashioned alternative. It's called companion planting, and the idea behind it is to plant together two or more crops that benefit each other.

Jerry Minnich of Madison, Wisconsin, has written several books on gardening. He says some plants help keep pests away from other plants. For instance, marigolds grown next to virtually any vegetable crop discourage pests. People used to think the flowers' pungent odor was responsible, but recent research has shown another factor to be important: Marigold roots produce three compounds that filter into the soil and kill several common plant parasites.

The effect of marigolds is scientifically confirmed. But generations of gardeners also swear by a host of other unconfirmed crop companions. The herbs rosemary and summer savory reportedly repel beetles from bean plants. Mint is said to keep away the cabbage butterfly. Chives and garlic are believed to drive aphids away from peas and lettuce.

But companion plants don't just protect each other from pests. Minnich says deep-rooted plants help break up the soil for weaker-rooted plants. And tall plants like broccoli help shade low-growing crops like lettuce from the withering heat of the summer sun.

It is still not understood how some plants benefit neighboring plants. But plenty of people are convinced that companion planting keeps gardens healthier without the use of a lot of chemicals.

■ ***June 1982***

■ Ocean Spray?

Algae from the ocean may someday kill insects on the farm.

Many farmers rely on pesticides to keep crops free of insects and to increase yields. But the chemicals can be ineffective if insect populations become resistant to them. And pesticides can be banned if they're too toxic to other forms of life. Consequently, pesticide manufacturers are always looking for new compounds that are both effective and safe.

Sea Grant chemist Joseph Hanke at the University of California-Berkeley suggests that pesticide companies turn to the sea.

> *One way of looking at the marine environment is that it's a gold field, and we can go out and mine the marine environment for chemicals that are new and therefore different.*

Using marine resources in agriculture is not new. For example, seventeenth century farmers used whale oil to kill insects in rice fields.

Someday, modern farmers may kill insects in the field with algae. Hanke has identified 14 species of red and brown algae that contain compounds lethal to insects. The chemist says much as a skunk protects itself by producing scent, algae defend themselves with toxins.

Hanke says it is not unusual for marine plants to protect themselves from insects because the plants face numerous threats from them. They may be eaten by the larvae of insects that have aquatic life stages. They may be exposed to air and to hungry insects when the tide goes out. And in deeper water, they may be on the menus of lobsters and crabs, which are close cousins to insects.

Hanke is currently testing the effectiveness of algae toxins against pests that plague cotton, corn and tobacco crops. He says because the toxins occur naturally, they could be safer to use than synthetic chemicals. ■ ***October 1987***

■ Casts of Thousands

The earthworm stirs and makes its cast,
By this we know it's spring at last.

That poetic tidbit is the creation of Francis Hole, professor of soil science and geography at the University of Wisconsin-Madison. Hole says he wrote the poem after he found several earthworm casts on the edge of a sidewalk one soggy spring day.

What's an earthworm cast? Hole says it's actually earthworm manure. As worms burrow through the ground, they move the soil and organic material through their bodies and deposit their casts throughout the soil. Hole says earthworm casts contain five to 11 times the amount of three major plant nutrients—nitrogen, phosphorus and potassium—as does the soil that contributed to the casting. The casts also improve the structure of the soil by making it more crumbly, so it drains and "breathes" better.

Hole says there are about 1,800 known species of earthworms. They vary by species from place to place according to types of soil. Some worms prefer the acidic soil and deep layer of needles in pine forests. Others live in the less acidic soils of hardwood forests or farm fields.

Oddly enough, says Hole, the most common earthworm, the night crawler, isn't a native of North America. It was brought here from Europe by early settlers. But the night crawler has made a comfortable home here and has given farmers and home gardeners a cheap and efficient means of improving the soil. ■ ***April 1982***

Salt of the Earth

Of all the natural compounds, salt may be the most puzzling. Our body fluids contain it, and in judicious amounts, our diets require it. We pay respect to salt in expressions like "he's the salt of the earth," "worth his salt," and even the warning, "take it with a grain of salt." But scientists believe this worthy compound is a growing threat to world agriculture.

They are alarmed by the gradual salting of croplands by irrigation—a practice born in the floodplain of the Tigris and Euphrates rivers 6,000 years ago in what is now Iraq. This Fertile Crescent, as it was called, once fed a population of between 17 million and 25 million people. Then it became too salty to sustain its crops, and now it is largely desert.

On lands with plenty of rain and drainage, the natural salts in water and soil are easily flushed into rivers and, eventually, the oceans. But in regions with little rain and particularly poor drainage, irrigation gradually deposits more and more salt in the ground. Evaporation from plants and soil releases essentially pure water to the air and further increases salt concentration. In California's San Joaquin Valley, many farmers must use 5 percent to 10 percent of their land for evaporation ponds to remove salt from irrigation water.

A recent report by the London-based International Institute for Environment and Development claims that salt has already reduced crop production on half the world's irrigated land. And the U.S. Department of Agriculture's Soil Conservation Service is investigating the salinity of this nation's soils. The agency hopes to persuade federal policy makers to give this threat high priority. For America's fruited plains, such as those in the Imperial and San Joaquin valleys of California, the threat is already real. ■ ***December 1984***

Chemical Controversy

Will genetic engineering one day make agricultural pesticides and fertilizers obsolete? Or will it make farmers more dependent on chemicals than ever before?

Biotechnologists hope to produce crop plants that resist pests and diseases and fertilize themselves. They say this would free farmers from the need to use large amounts of chemicals in the field. One industry official even calls genetic engineering a "back-to-nature" technology.

But Terri Goldberg of the Committee for Responsible Genetics in Boston disagrees. Goldberg says one of the major thrusts in biotechnology at present is to create plants that are more tolerant of chemical herbicides so the two can be tied together.

> *I don't see this back-to-nature movement happening in the biotechnology companies. I see exactly the opposite. In fact, many of the companies that produce herbicides are those companies that are most actively interested in producing new seed varieties that will utilize more and more herbicides.*

And more herbicides, says Goldberg, could cause greater environmental harm and pose potential health problems.

Robert Molz of the DuPont Corporation disputes the claim. Molz says the advent of herbicide-resistant plants would enable farmers to use new, less-toxic chemicals in smaller amounts.

> *And what all this is going to translate into is lower cost of production for the grower, and that will translate into lower costs at the supermarket for you and me. I think it will be environmentally less damaging and result in greater safety to the growers and applicators who use these chemicals.*

Molz maintains that new, herbicide-resistant crops would be just the first step toward chemical-free farming. ■ ***May 1985***

■ Preventable Pollution

Barnyards and feedlots are a big source of water pollution in the dairy lands of Wisconsin. But they don't have to be.

Fred Madison, a University of Wisconsin-Extension soil scientist, says farmers can prevent storm water from sweeping manure off their farms and into streams and lakes.

> *Divert the water upslope. Keep as much water out of the barnyard area as you can. And then, if necessary, collect what water runs out of the barnyard-feedlot area and treat it before it's introduced to a waterway.*

Madison says diversion ditches upslope, gutters and downspouts on barns, and other precautions can steer most runoff away from places where livestock congregate. He says catch basins downslope from those places can trap the rest and hold it until the manure settles out.

What can farmers do with manure? Madison says they should spread it on their fields to replenish the soil. He believes this is generally safe even in winter, when the ground is frozen and cannot absorb manure right away. But he says there are exceptions.

> *Where farmers do not have land—sufficient land of the right kind of slope and thickness and separation from streams—to spread the wastes that their cattle will generate during the wintertime, then storage for the winter months is an appropriate water-quality protection strategy.*

Farm improvements to stop water pollution cost money, of course, and that's something many farmers are short of these days. A new $1 million state fund will give qualifying farmers in Wisconsin up to $10,000 each toward those expenses. Madison says a million dollars is not enough to help everyone who needs it, but it's a start.

■ ***August 1984***

■ Swept Away

Every day, winds whip across open fields and sweep away clouds of dust. Rain carves gullies into unprotected hillsides. The result is soil erosion. It happens mostly on farms, but it occurs in towns and cities, too.

Leonard Johnson, a soil conservationist with the University of Wisconsin-Extension, says land development and construction sites are most vulnerable.

> *Because the land is disturbed, it's open and susceptible to active erosion, and a lot of soil can be moved off. The amounts of soil lost per unit area can be truly massive—you know, 10 to 100 or more times what you might get from an agricultural cropland area.*

Johnson says *urban* soil erosion can be a big nuisance. Loose soil piles up on streets and clogs storm sewers. It also washes into lakes and streams, adding to water pollution.

But Johnson says developers and contractors *can* control soil erosion.

> *There are some relatively simple and effective things they can do, in the technical sense, in terms of land stabilizing measures, vegetative practices, using mulches, using temporary sediment-retention structures, just managing how the surface water runs, retaining it where appropriate, and protecting the soil surface from raindrop impact and from runoff.*

Some communities and states with severe urban erosion require special protection for construction sites. But no matter where it happens, Johnson believes it is in the best interests of land developers to prevent erosion. ■ ***February 1982***

■ Coon Valley's Milestone

Coon Valley, located in southwestern Wisconsin near La Crosse, was once plagued by severe erosion. Today, Coon Valley is hailed as a showcase for soil and water conservation.

Nearly 50 years ago, the federal Soil Conservation Service picked Coon Valley—an area of rough, rolling terrain—to become the nation's first major target for erosion control. The area had seen two generations of intensive agriculture and had suffered droughts and floods. It bore scars in the form of barren hillsides, numerous gullies and streams that were choked with eroded sediment.

Many Coon Valley farmers saw erosion ruin their land. In 1933, with help from the Civilian Conservation Corps, they adopted new ways of farming. They began rotating crops, building grassed waterways and terracing steep slopes. They also planted crops in alternating strips that followed the contours of the land. Over the years, these innovations slowed the velocity of storm runoff and helped rebuild the soil.

Because these conservation measures were taken, the gullies have healed over and the land is productive again. Today, the streams in Coon Valley are flowing clearer because less eroded sediment washes into them. The numbers of fish and wild animals in the area—such as trout, deer and ruffed grouse—have increased substantially.

The lessons learned at Coon Valley have been long-lasting and widespread: They've helped establish soil and water conservation techniques that are applied not only in Wisconsin and elsewhere in the upper Midwest, but overseas as well.

■ ***August 1982***

■ The Great Land Loss

Louisiana has 40 percent of the nation's wetlands, but 50 square miles of those wetlands wash into the Gulf of Mexico each year. The state suffers the greatest losses of any state in the country to coastal erosion.

That land loss may increase the price we pay for seafood and energy. As Louisiana's wetlands erode, important nursery grounds for fish and shellfish disappear, and when catches go down, seafood prices go up. New restrictions on energy exploration in the wetlands could slow this erosion, but they also could make natural gas and oil more expensive to extract.

Louisiana State University marine scientist Eugene Turner says the dredging of canals is the biggest culprit in wetland erosion. He says his studies indicate that dredging canals to find and extract oil and natural gas in the wetlands accounts for at least 50 percent of Louisiana's coastal land loss.

In places, canals in Louisiana's coastal wetlands are as dense as streets in a crowded subdivision. It's not just the land destroyed by dredging that has people worried. The bigger problem is that the canals interrupt the flow of sediments and nutrients through the marshes. These materials nourish the growth of marsh ecosystems: Without a continuous supply of sediments and nutrients, these fragile areas subside or break up in storms and wash away.

Piling the dredged materials, or spoils, in banks along the canals has divided the marshes into impounded fragments. Turner says the spoil banks keep water from flowing between marsh and adjacent waterways, and many marsh areas have turned into ponds and lakes, some with telltale rectangular shapes.

There are new restrictions on dumping dredge spoils to protect the wetlands. But, Turner says, Louisiana will continue to suffer as a result of 50 years of virtually unrestricted dredging.

■ ***March 1983***

■ Across the Fruited Plain

It's a parcel of living history with vistas like those the first settlers faced as they moved west: a veritable sea of grass, shining amber waves harboring a multitude of plants and wildlife.

The Konza Prairie stretches almost 9,000 acres across Kansas. It's the last place in America where unspoiled remnants of the Great Plains still reach as far as the eye can see. Lloyd Hulbert and other biologists at Kansas State University have studied the Konza for more than 25 years.

They are trying to understand how its many components—plants, insects, birds, mammals, soil and streams, to name a few—survive and interact. Hulbert says learning how prairies maintain themselves helps protect the remaining patches. It also benefits agriculture: Prairie researchers learn about grassland management techniques that are useful on grazing lands, and they also learn what kinds of soils prairies form and how they stay productive.

Kansas State bought a thousand acres of the Konza Prairie in 1971. The Nature Conservancy, a private land-preservation organization, bought nearly 8,000 more acres six years later. That assures that the prairie will remain forever wild.

The National Science Foundation has given Hulbert and his colleagues a long-term research grant to continue studying the Konza. The university now has six full-time scientists at work there, and Hulbert says this priceless remnant of the Great Plains will provide research opportunities for generations to come. ■ ***July 1984***

■ Harvest of Dust

The world is losing fertile land at a startling rate, according to the United Nations. And it's happening fastest in places that can least afford it.

UNEP, the United Nations Environment Programme, estimates that 52 million acres of range and crop land are reduced to wasteland every year. That's an area roughly the size of Minnesota, and UNEP says people are to blame.

In developing countries with fast-growing populations, people are trying to squeeze more from the land than the land can give. They're farming it too intensively, grazing too many animals, irrigating poorly and cutting too many trees. All of that leaves the land barren and infertile—a disaster in places where food, water and other necessities are already in short supply.

The process is called desertification because the abused land, usually dry to begin with, becomes desert. UNEP says up to a third of the world's land, including large parts of Africa, Asia and the western United States, is susceptible to desertification. One of every five people in the world lives in those areas and would suffer if the land became useless.

Unfortunately, once it starts, desertification is hard to stop. People driven off the land by their own misuse of it tend to go elsewhere and repeat their mistakes. And each time they move, the problem grows worse as more people try to survive on less land.

The United Nations Environment Programme says desertification can be stopped, but it will take an international commitment of perhaps $90 billion over the next 20 years. The money is needed to promote environmentally sound development and careful resource management where desertification threatens. The price is high, but UNEP says the price of doing nothing could be much higher. ■ ***June 1985***

■ Patches of Haven

The finest pieces of wild America are found in the national parks, right? That's what most people think. But in fact, the lesser-known system of national wildlife refuges is bigger, wilder and possibly more important.

President Teddy Roosevelt started the National Wildlife Refuge System in 1903, 30 years after the creation of the first national park. He set aside Pelican Island, located off Florida's coast, as a haven for wildlife, not a tourist attraction for people. Now, 80 years later, more than 750 refuges provide essential habitat for over 800 species of birds and mammals. Alaska's share alone covers more area than all of New Mexico. Every state but West Virginia has refuge land.

The system has proven to be a last resort for saving habitat. As America's frontier succumbed to plow and rail, habitat crucial to wildlife was destroyed. In some cases, whole species, such as the bison, were nearly wiped out. But a thoughtful group of sportsmen—hunters, mostly—realized that their dwindling supply of game was not merely bad luck. They knew something had to be done.

The National Wildlife Refuge System, which is run by the U.S. Fish and Wildlife Service, is now the foremost habitat-preservation effort in the world. Some refuges, like the Arctic National Wildlife Refuge in Alaska, are pristine wilderness. Most are not. It is the smaller sites—a swamp in New Jersey or a prairie in the Dakotas—that allow wildlife to live and breed in areas where most of their habitat was destroyed.

The laws that protect wildlife refuges are less stringent than those protecting national parks. Private and public interests—such as mineral leases—constantly threaten the refuges. Nonetheless, they are patches of haven for embattled wildlife across the nation. ■ ***March 1984***

■ Paradise Lost

A hurricane that destroyed houses along the Texas coast also blew away private property rights.

When Hurricane Alicia roared into Texas in 1983, houses along Galveston's shoreline crumbled in the gale. The high winds also blew up a legal storm that has cost some homeowners their beachfront property.

The state barred owners of several damaged homes from rebuilding. The Texas Open Beaches Act declares land between the ocean and natural shoreline vegetation to be public property. Hurricane Alicia eroded the beach and pushed the vegetation line back 150 feet. That left 300 parcels of *private* property, some with beachfront houses, on what had become *public* beach under Texas law. The state confiscated the land. The owners filed suit, claiming Texas unconstitutionally seized their property.

The case went all the way to the U.S. Supreme Court. The court refused to hear an appeal, upholding the state's argument that beaches are public property.

Texas assistant attorney general Kenneth Cross says the state's Open Beaches Act accommodates changes in nature.

> *When you're talking about the natural landforms down along our coastal areas, it has always been a tradition and always been the law that as nature moves and reshapes the coastline, then the property rights change along with those natural processes. And all that we have done is follow that tradition in these Hurricane Alicia cases.*

Cross says nature, not the state, really took the oceanfront property. He says people who build on hurricane-prone beaches assume that risk. In Galveston, Texas, some beachfront homeowners gambled and lost. ■ ***August 1987***

■ This Land is Your Land

Three and two-tenths acres—that would be your personal share if all the federally owned land in the United States were parceled out evenly to every man, woman and child in the country.

A third of the nation's land—740 million acres—is still in federal hands. Most of it is west of the Rocky Mountains and relatively undeveloped. And while the government is not likely to carve it into personal-sized chunks, it remains our common property.

The land is extremely diverse. It includes everything from deserts and vast grasslands to mountains and dense forests. It is rich in coal, oil, natural gas and other fuels. It is a vast storehouse of important minerals and priceless timber. Grizzly bears, bald eagles and bighorn sheep take refuge there. And it has some of the most spectacular scenery on the planet.

Small wonder that the future of this land has become a major public issue. Demand for all of its treasures is growing. Once, there seemed plenty of everything to go around. Now, drilling for new oil may mean sacrificing a bit of wilderness. Protecting bears may mean foregoing a timber harvest. *Choosing* one treasure may mean *losing* another, and so people with special interests in these treasures are spending a lot of time, energy and money to persuade the federal government to see things their way.

Preservationists had the upper hand during the Nixon, Ford and Carter years. Development interests gained favor when President Reagan took office. Nobody knows who will prevail in the future. It's safe to say that the political battle over the use of federal lands is likely to intensify as the nation's appetite for natural resources grows, and the outcome of that battle will touch us all.

■ ***March 1983***

■ An Outpost of Nature

Close your eyes and clear your mind. Now, what's the first thing that pops into your head when someone says "New Jersey?"

Factories and smokestacks? Gambling casinos and the Atlantic City boardwalk? Sprawling suburbs in the shadow of the Manhattan skyline?

If so, you may be surprised to hear this: New Jersey is the home of a wildland reserve almost as big as Grand Canyon National Park. It's called the Pinelands National Reserve, or simply the pine barrens. And while it may not knock your socks off the way the Grand Canyon does, it's still an impressive outpost of nature on the doorstep of the eastern megalopolis.

The early waves of East Coast development simply bypassed the pine barrens. Except for a flurry of iron mining in the 1850s, they remained an economic backwater—a flatland of forests, bogs and streams. Only recently, when city-dwellers began seeking a rural escape, did the pine barrens catch their eyes. But by then, large tracts had become state forest, and attempts to fill the rest with vacation homes and resorts raised an outcry from people who wanted the area to remain wild.

Today, the Pinelands National Reserve is a patchwork quilt of public and private land. It is *not* wilderness. Cranberry and blueberry farms ring the perimeter, and several small towns dot the interior. The 15-member New Jersey Pinelands Commission has the difficult job of regulating growth in the area without strangling local economies.

The reserve is a haven for birdwatchers, hikers, canoeists and others who seek respite from the cities nearby. The question now is whether the pine barrens can stand the growing influx of recreationists. Their very numbers have shaken its solitude and put new pressures on this outpost of nature at the doorstep of megalopolis.

■ ***August 1984***

■ Forest Lawns

A carpet of green grass is still the preferred lawn for most homeowners. But more natural plantings are creeping into America's neighborhoods.

At least 2,000 people are reconsidering mowing their lawns this summer. That's how many contacted the National Wildlife Federation last winter to find out how to landscape their yards to attract wildlife. The federation's Backyard Wildlife Habitat Program offers advice on planting that provide food and shelter for birds, mammals and butterflies.

Coordinator Toni Pepin says that since the program began in 1973, thousands of people have converted their yards to little woodlots or prairies. Pepin says for those folks, flat, sterile lawns just aren't enough.

> *I think people are looking at their yards, wanting to do as much as they can with the small amount of space they have, trying to make it favorable to wildlife so they can have the enjoyment of getting to see neat critters in their back yards. They can have lots of fun, just looking out their back doors and out their back windows.*

Natural lawns also require less maintenance. Rain soaks in better, so yards need less watering. Leaves and sticks are best left to decompose on the ground, where they provide natural fertilizer. And of course, mowing is out of the question.

Those who have switched to natural landscaping find beauty in their new plantings. But not everyone likes unmanicured lawns in their neighborhoods. Cities like Fort Wayne, Indiana, specifically prohibit natural or wildlife habitats in residential areas. A few communities, however, are more tolerant. Madison, Wisconsin, for example, has an ordinance that allows people to cover their yards with *native* plants such as prairie grasses or wildflowers. The only catch is that all the neighbors must approve. ■ ***April 1986***

■ Nature's Way

People have drastically altered the face of the Florida Everglades in the last century. Now the state of Florida wants to undo some of the damage that's been done.

When Florida became a state in 1845, the first legislature declared the Everglades swamp worthless and asked Congress to help turn the area into usable land. Thirty-five years later, the state sold four million acres of the Everglades to Philadelphia manufacturer Hamilton Disston and promised to *give* him more if he drained it.

In the decades that followed, Disston and other developers built large canals and dikes to stop the natural flow of water from Lake Okeechobee through the Everglades to the Atlantic Ocean and Gulf of Mexico. Farmers moved in to grow crops on the former wetlands. Then came urban developers, who helped turn south Florida into one of the fastest-growing population centers in the country.

Only recently have people realized that the Everglades region is far from worthless. It's one of the richest wetland areas in the world and a haven for water birds. Ninety percent of the commercially valuable fish in the ocean surrounding the Everglades spend part of their lives in its salt marshes. The water that flows through the Everglades replenishes the underground reservoir that is the only source of fresh water in southeast Florida. And finally, Everglades National Park draws 600,000 tourists a year and generates up to $30 million in tourism revenue.

With that in mind, the state of Florida embarked on a plan in 1983 to restore some of the natural water-flow patterns in the Everglades and to add new wildlife preserves. Governor Bob Graham is one of the plan's strongest supporters. Graham notes that human disturbance has, among other things, sharply diminished wildlife and fish populations in the Everglades and threatened public water supplies. It's time, the Florida governor says, to help nature take its course once again in the Everglades. ■ ***October 1985***

■ Locked Out

Congress added more land to the federal wilderness system in 1984—8.5 million acres—than in any year since it passed the Wilderness Act two decades ago. Now almost 90 million acres of federal land are off-limits to logging, mining and similar commercial pursuits.

That's good news to wilderness advocates but bad news to Charles Parks, a Stanford University geologist. Parks thinks wilderness preservation has gone too far, locking up land that may contain valuable energy and mineral resources. He fears the United States will run short of critical materials in 10 to 20 years if new sources are not found and developed. He claims areas considered for wilderness designation are not explored carefully enough for mineral deposits beforehand. And he says where deposits exist, their future value is often ignored.

Parks says the Glacier Peak Wilderness Area in the Cascade Mountains of Washington state is a good example. Glacier Peak contains a major copper deposit that has to stay in the ground because mining is outlawed there. Although there's no shortage of copper now, Parks feels we may regret the decision if copper becomes scarce in the future.

The California geologist insists he loves the outdoors but feels public lands should be used to better advantage. He believes, for instance, that the government should lease federal lands now off-limits to mining companies on the condition that the lands be restored once mining is completed.

But preservationists contend there's no way to restore a former mine site to wilderness. Ultimately, they believe undisturbed natural lands are more valuable than anything that lies beneath them. And as Congress recently demonstrated, sometimes it agrees. ■ ***November 1984***

■ The Value of Nature

Your good health depends on a regular dose of nature.

Consider these facts:

- Hospital patients with views of trees and other greenery recover more quickly than patients in rooms without such views.
- Prison inmates whose cell windows overlook natural landscapes seek health care less often than prisoners with less desirable views or none at all.
- Office workers who can see pleasant outdoor settings from their desks report feeling healthier and less pressured than workers who cannot.

Environmental psychologists Rachel and Stephen Kaplan of the University of Michigan discuss these and other research findings in a new book called *The Experience of Nature*. The Kaplans consider the findings strong evidence that contact with nature is more than just pleasurable, it's a fundamental human need.

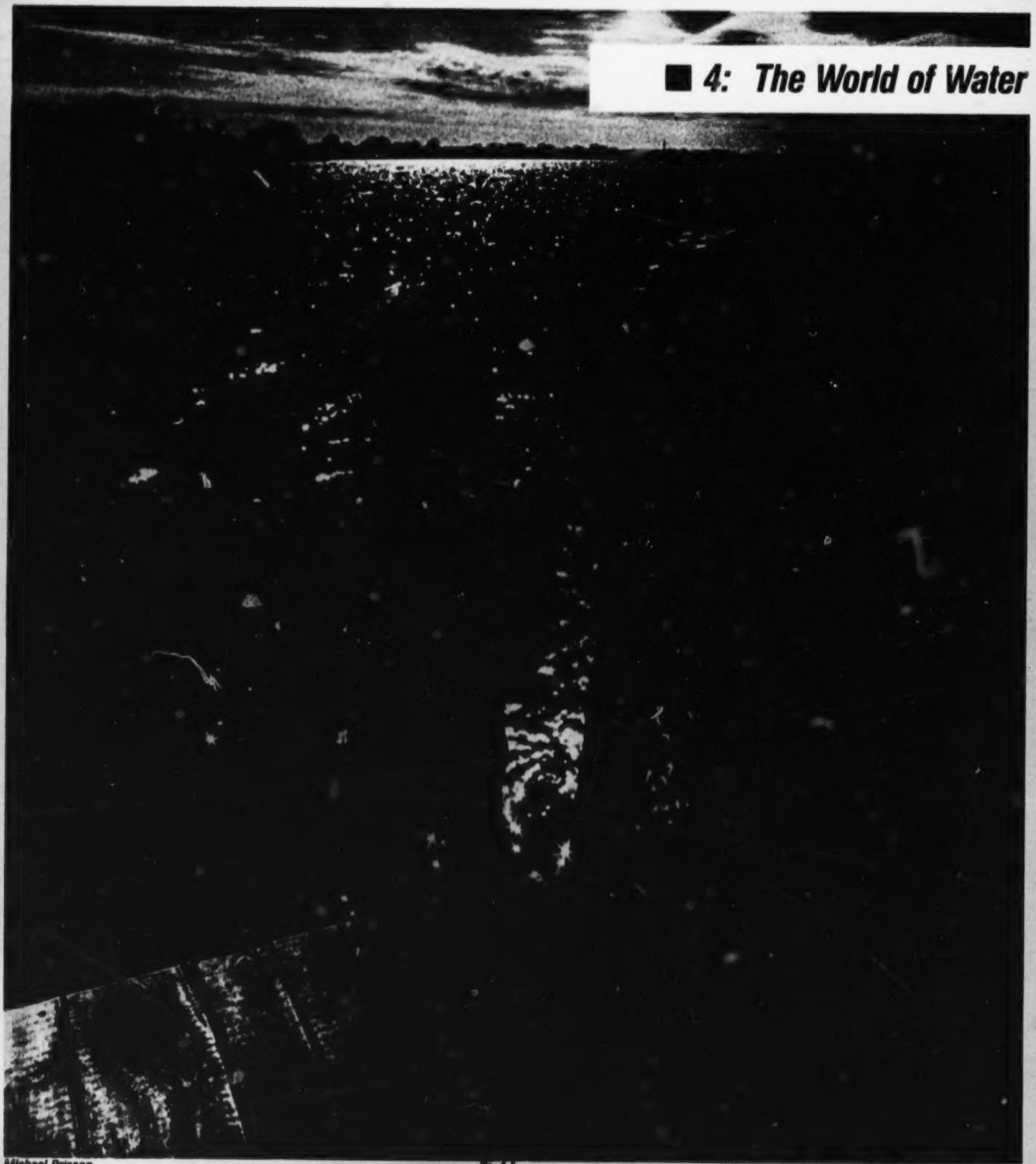
One message that emerges from their study is that public investment in parks, gardens, greenbelts and other natural things is not frivolous, as some taxpayers claim. Another message is that public officials should not judge the benefits of such investments strictly in dollar terms.

Rachel Kaplan explains:

> *In our book, we discuss the many ways in which the importance of nature shows itself and the implications of this for public policy. I think the accumulation of evidence is more powerful than any dollar amount you might try to assign to the value of nature. There are so many converging forces that show how important nature is to people that, in the long run, we can't afford to ignore them.*

The Kaplans say scientific evidence of the link between nature and the human psyche is relatively new but growing. By all indications, the link is a vital one. ■ ***October 1989***

■ 4: The World of Water



Michael Brisson

■ Surf and Turf

The coastal zones of the world's oceans cover as much space as all the dry land on Earth. More than a hundred nations of the world on the ocean coasts are struggling to share and protect these critical areas.

Coastal zones provide most of the world's food fish. Demand for fish is expected to double by the end of the century. Much of the new demand will come from coastal areas of the Third World nations.

Whether the oceans can meet the demand is questionable. Modern equipment helped fishing fleets triple the world catch from 1940 to 1970, but it also let them overfish parts of the oceans, and some important fisheries collapsed. The competition for what was left prompted a number of coastal nations, including the United States, to extend their claims to fishing rights to 200 miles offshore.

A new Law of the Sea Treaty, adopted by the United Nations in 1982, recognized 200-mile limits worldwide. That placed virtually all of the world's fisheries under the jurisdiction of national governments.

Some countries immediately reaped the benefits of their new ocean territories. Others could not. Canadian fishermen, for instance, have caught more northern cod than before, and the size of their catch keeps growing because foreign fleets no longer have access to Canada's waters. On the other hand, many island nations in the Indian and south Pacific oceans lack the tools, experience or labor to catch migratory fish that pass through the vast fishing grounds they claim.

What's more, the Law of the Sea Treaty displaced some long-time fishing nations like Japan, Spain and Germany, which traditionally took most of their fish from waters now claimed by other countries. And the treaty has failed to settle quarrels like that over the Baltic Sea, where several countries share fishing rights but cannot agree on how much fish each nation should harvest.

■ ***October 1984***

■ Big Bucks in Boats and Bait

Anglers who throw their lines into the Great Lakes also throw a few billion dollars into the Great Lakes economy.

Twenty years ago, fishing on the Great Lakes was all but wiped out. Pollution, sea lampreys and overfishing had destroyed stocks of valuable fish such as lake trout and perch. In response to these problems, the United States and Canada began programs to restore Great lakes water quality and fisheries. Efforts to control pollution and sea lampreys, along with massive fish-stocking programs, have paid off. The Great Lakes fishery has recovered. Now sport and commercial fishing are major contributors to the region's economy.

A recent report to the Great Lakes Fishery Commission details the benefits the renewed fisheries bring to the upper Midwest. The report says commercial fishing in the Great Lakes region generates about $270 million a year. Great Lakes sport fishing is even more valuable; it pumps about $4 billion a year into the region's economy.

Richard Bishop, a University of Wisconsin-Madison economist, says these figures provide a strong argument for continued management and pollution control on the Great Lakes. However, Bishop, who helped produce the report, says it should *not* be used to argue for restrictions on Great Lakes commercial fishing just to benefit the more valuable sport fishery.

> *We need to think about being flexible. We know that the Great Lakes ecosystem is in a state of flux. We need to think in the long run about our abilities to capitalize on wherever that resource goes next.*

Bishop says commercial fishing on the Great Lakes provides employment and valuable trade today and a way for resource managers to control the balance of Great Lakes fish populations in the future. ■ ***May 1987***

■ Krilling Fields

The Antarctic Ocean teems with millions of tiny creatures called krill that several countries harvest as a source of protein. Some scientists wonder how that will affect life in the Antarctic.

Tiny, shrimp-like animals called krill congregate in huge swarms in the Antarctic Ocean. Some scientists estimate that full-scale harvesting of krill could more than double the world's total annual catch of fish and shellfish.

Krill are consumed primarily by whales, sea birds, penguins, seals and fish. Michael Macaulay, a marine biologist with the University of Washington Sea Grant program, says humans can now be added to the list of predators.

> *One of the reasons why krill has become an issue is that it's now being considered both for human consumption and for animal feed. Some people think that because the whales have become so depleted, there's perhaps a surplus of this animal in the Antarctic. I think it remains to be seen whether there's an enormous surplus: It's been estimated at perhaps 150 million metric tons.*

Macaulay says the Soviet Union is currently harvesting about 200,000 metric tons of krill annually, and Japan harvests between 25,000 and 75,000 metric tons. The size of the harvest varies depending on market demand.

Macaulay and other researchers fear that larger harvests will upset the balance of the food chain. The Antarctic Ocean is geographically and climatically isolated, and it is not known exactly how many animals depend on krill as a food source. Macaulay says until we learn more about the abundance, distribution and basic biology of krill, we risk depleting not only this potential new food resource but also the many other marine animals that depend on it. ■ ***July 1985***

■ Silent Net

Fishermen have laid nets in the sea for centuries. But some modern nets, once abandoned, continue to catch and kill fish and other animals for months.

Nets used in the open seas are called pelagic driftnets. Some of them, gillnets, are made of plastic webbing suspended vertically in the water by floats and weights. The buoyancy can be adjusted to hang the net at any depth. Pelagic driftnets are virtually unbreakable and can be thousands of yards long.

According to marine consultant Robert Eisenbud, gillnets are not biodegradable. And when used indiscriminately, gillnets can kill many fish that are never harvested. Eisenbud says the nets not only catch fish but also snare birds and marine mammals. He says about 10,000 porpoises die in driftnets each year.

Lost and discarded nets may also be a problem, but some nets are not lost unintentionally. Eisenbud says U.S. aircraft have observed foreign boats fishing in protected water. Once the intruders discovered they were under surveillance, they cut their driftnets to make a quicker getaway.

Sometimes abandoned gillnets wash ashore, but usually they continue to catch fish until the weight of the catch drags them to the bottom. According to Eisenbud, castaway gillnets can drift aimlessly for months or even years and continue to catch fish, mammals and birds.

He adds that in the North Pacific alone, fishermen from Japan, Taiwan and Korea set about 20,000 miles of net a day. That adds up to more than a million miles of fishing net a year.

Eisenbud says it is up to the nations involved to address the dangers of indiscriminately deploying gillnets or to find alternative methods of fishing. ■ ***August 1985***

■ Down Under, Down Under, A Big Fishing Plunder

Less than fifteen years ago, the pristine waters off Antarctica were rich with marine life. Today those waters are fish-poor.

Antarctic waters once seemed too remote for profitable commercial fishing. But a treaty negotiated during the 1970s changed that.

The treaty is the Law of the Sea. The international agreement allows countries to extend their jurisdiction over coastal waters out to 200 miles. Many areas that were once international fishing grounds became restricted. Several eastern-bloc countries—including the Soviet Union, Poland and East Germany—were shut out of their traditional fishing grounds. They turned to Antarctica and began to fish there in the early 1970s. Their catch peaked at nearly a half million tons in the 1979-1980 season. It has since plummeted to nearly a tenth that amount.

Kenneth Sherman, chief scientist of the Antarctic Program for the National Oceanic and Atmospheric Administration, says the decline occurred because Antarctic fish stocks are different from those elsewhere.

> *We're looking at fish populations that have evolved over the millennia, with no perturbation of the kind that can be imposed in a relatively short period of time by the efforts of man-the-predator using big fishing nets over the bottom.*

Sherman says the cold-water fish grow at rates nearly half that of fish living in warmer waters. This and other factors significantly change the amount of fish that may be taken yearly without harming the fishery.

A joint U.S.-Polish research team, part of a 19-nation committee that oversees Antarctic marine resources, is now studying the situation. Sherman is optimistic that international agreements to protect the fishery can be reached soon and the once-rich fishing grounds will regain their lost vigor.

■ ***May 1987***

■ The South Rises Again

One of the most toxic compounds contaminating the Great Lakes is toxaphene, a pesticide now banned in the United States.

Around the Great Lakes, the names of some pollutants—PCBs, dioxin, dieldrin—have become household words. But one chemical, toxaphene, has received considerably less publicity, though researchers say it is potentially as dangerous as the others.

Toxaphene, they say, found its way to the Great Lakes by an unexpected route: the air. According to John Sullivan, a Wisconsin Department of Natural Resources environmental scientist, most of the toxaphene that entered the Great Lakes originated in the southern United States and was carried north by the wind.

Sullivan, coauthor of *Toxaphene Status in the Great Lakes*, a recent report by the University of Wisconsin Sea Grant Institute, claims that even though it is banned, enough toxaphene was carried from southern soils to create problems.

> *When it was used in the United States, it was used largely on cotton crops in the southern United States. And through volatilization of the pesticide from the treated croplands and ultimately reaching the atmosphere, it was being transported from the southern portions and certain western portions of the United States to the Great Lakes basin and reaching the basin through atmospheric deposition, both wet and dry types of deposition.*

Like other long-lasting contaminants such as PCBs, toxaphene can end up in the food chain. First absorbed by plants and microscopic animals, it can concentrate in waterfowl and in some large fish, particularly trout and salmon. And as with other contaminants, there are more questions than answers about the effects—if any—that eating toxaphene-tainted fish might have on humans.

■ ***January 1986***

■ Our Brimming Great Lakes

A scientist says we may have misjudged the influence of climate on the brimming Great Lakes.

Record high water levels in the last two years have caused great anguish among Great Lakes shoreline residents. Waves are flooding low shorelands, topping sea walls and eroding coastal bluffs. However, the chief hydrologist at the federal Great Lakes Environmental Research Laboratory in Ann Arbor, Michigan, says the lakes are only doing what comes naturally.

Frank Quinn says old shorelines and lake sediment samples indicate climate conditions of centuries past. He says what is considered the region's normal climate may not be so normal after all.

> *The period from about 1930 to 1960 may very well have been about the warmest 30-year period in the last 2,000 years. It was also extremely dry. We've built our economy around the Great Lakes based on what may very well be dry, low lake-level conditions. And current conditions, with the rather cool and wet climate and high lake levels, may very well be the norm when we look at the last 2,000 years or so.*

Quinn has modeled the effects of various climatic conditions on the Great Lakes. He points out that three times in the last three years, the lakes have exceeded levels predicted to happen, on average, once every hundred years. He says lake levels could go higher and persist indefinitely.

> *For example, we know that if we get several more years of the wet conditions that we had in 1985 and '86, it's possible for Lake Michigan to go up another foot and a half or so over the next three years.*

Quinn says people must take into account possible long-term changes in climate and higher water levels in the Great Lakes. ■ ***February 1987***

■ A Costly Diversion

Diverting water from the Great Lakes could ultimately cost industries in the region millions of dollars.

In some arid western and southwestern states, demand for water is growing while supplies are diminishing. Some people envision piping water from the Great Lakes to help meet the demands of the Sun Belt.

Erhard Joeres heads a University of Wisconsin-Madison research team investigating how diversions might affect Great Lakes water levels and certain Great Lakes industries. The researchers investigated one scenario that would remove 10,000 cubic feet of water per second out of Lake Superior. They found that over five years such a diversion would lower water levels in Lake Superior by as much as two feet and those in Lakes Michigan and Huron by eight inches.

Joeres, a civil and environmental engineer, says the team then determined how much the drop in water levels would affect two major industries.

> *The economic analysis really was a matter of trying to come up with some real numbers on how shipping and hydropower were dependent on water levels.*

Economists on the team found that lower water levels would force Great Lakes ships to carry lighter loads and therefore make more trips. Lakeside hydroelectric power plants would have to cut electricity production and turn to more expensive coal or nuclear energy. Research team member Stuart Rosenthal explains:

> *The effects of that type of diversion would be between $70 million and $95 million per year. The effect of any diversion appears to be roughly 10 times as great on hydropower production than on shipping in terms of total costs.*

Joeres says these estimated economic losses are relatively small compared to the adverse effects diversion could have on water quality and fisheries in the Great Lakes. ■ ***September 1985***

■ Down the Drain

If it rains heavily in Milwaukee today, the city's sewers are likely to overflow into Lake Michigan. But a network of tunnels could one day put Milwaukee on top of the problem.

Modern sewer systems are built with two separate networks of pipes—one for sewage and another for stormwater. But Milwaukee's turn-of-the-century sewer system carries both. And a heavy rainstorm, combined with the city's normal output of sewage, is more than the system can handle. Such storms often force the city to release rainwater and untreated sewage from the overburdened sewer lines into Lake Michigan and its tributary rivers. That, of course, pollutes the lake.

Milwaukee plans to spend $2.4 billion on improvements during the next decade to remedy the problem. One sewerage district official says it'll be the largest wastewater construction project in the nation.

Besides installing better pipes and more modern treatment plants, Milwaukee will dig 17 miles of giant tunnels to hold the overflow when there's a downpour. The deep tunnels, as they're called, will range up to 30 feet in diameter and hold as much as 275 million gallons of wastewater until treatment plants can process it.

The idea is simple, but its construction is not. At a cost of roughly $13 million a mile, a giant machine called a mole will bore out thousands of tons of rock to form the tunnels. But first, the 900-ton mole must be lowered piece-by-piece down a 300-foot shaft and assembled.

The big question is whether the tunnels will work. The Milwaukee Metropolitan Sewerage District insists they will. The Wisconsin Department of Natural Resources is not so sure. The DNR says the tunnels may have to be lined with concrete—at additional cost—so they won't leak. But the agency will wait to see until the first tunnel section is built. ■ ***July 1985***

■ Probing a Great Lake's Plumbing

Some communities in the Great Lakes basin still depend on groundwater for their water supplies. Mequon, Wisconsin, a suburb of Milwaukee, is one of those communities, and surprisingly, several wells there are going dry.

Heavy use of well water for homes and golf courses in Mequon has drawn down the groundwater in one area. The result is what hydrogeologists call a "cone of depression." In this local spot, groundwater has dropped 40 feet below the level of Lake Michigan. In Wisconsin, groundwater normally flows eastward into the lake. But Mequon's cone of depression is drawing water back the other way.

Douglas Cherkauer of the University of Wisconsin-Milwaukee says this reversed flow highlights the critical relation between Wisconsin's aquifers and Lake Michigan.

> *We know how much river water flows in, and we know how much rainfall goes in. We probably can approximate how much water evaporates off the lake. But we have no idea how much water flows in underground.*

Cherkauer's Sea Grant research team has been checking groundwater levels and movements in other Wisconsin coastal areas as well. The researchers have used electronic devices offshore to detect porous lakebeds where seepage in or out of the lake could take place. Special devices planted in the lakebed itself have measured rates of actual seepage.

The objective is to piece together a map that reveals the present and potential movements of groundwater along Lake Michigan's western shore. This work should help communities like Mequon take steps to protect the quantity *and* quality of water sources in a developing area of the Great Lakes region. ■ ***March 1983***

An Island in Distress

"Water, water everywhere, but not a drop to drink." That old adage may become all too true for the three million people who live on Long Island in New York.

Long Island is surrounded by the Atlantic Ocean. But converting seawater to drinking water is costly, so the islanders rely on wells that tap the groundwater beneath them. Unfortunately, that water is becoming polluted.

About half the rain that falls on Long Island eventually becomes groundwater. As it filters through the soil, the rainwater picks up traces of chemicals from old dumps and landfills, agricultural pesticides and other contaminants. Besides that, Long Islanders are using their groundwater faster than the rain can replace it. Seawater is seeping in to fill the gap, contaminating the groundwater with salt.

Sarah Meyland belongs to a New York state legislative commission that is studying Long Island's water problems. She says better management of activities on the land is the key to protecting the groundwater.

> *The solution is going to be to try to protect those parts of the land that are still pristine, to protect those parts of the aquifer that are still pristine, so that we will have pristine water in the future in some places. Some parts of the island will probably have to have treatment. We'll probably have to start sharing our water on more of a regional basis. We would like to ultimately see regional management of the aquifer system.*

Meyland believes Long Island's communities can preserve their drinking water by adopting new zoning laws, phasing out landfills, limiting industrial growth and minimizing the use of fertilizers and pesticides. ■ ***June 1983***

Hidden Polluters

Some of the most serious polluters of groundwater are underfoot and out of sight.

Every community has underground storage tanks—at service stations, schools, factories, farms, hospitals and elsewhere. The tanks store everything from gasoline to chemical wastes. There may be 2.5 million of them in the United States, and it's estimated that as many as 100,000 of them are leaking.

Most tanks are made of steel and built to last 20 to 30 years. When they get older, they rust, and eventually they leak. Leaky storage tanks threaten groundwater in many parts of the country, including the upper Midwest, but nowhere have they been more troublesome than in Florida, where the water table is high, soils are porous and sandy, and groundwater is especially vulnerable.

Most of Florida's population gets its drinking water from the ground. But many of the state's underground storage tanks leak fuel or chemicals into that water. In Belleview, Florida, 10,000 gallons of gasoline seeped out of an underground storage tank a few years ago. Two years later, gasoline turned up in all three of the community's drinking-water wells, and they were shut down. The people of Belleview had to truck in fresh water for more than a week. After that, they had to boil all the water they got from a temporary well for eight months until a new permanent well was drilled. Ironically, Belleview had once boasted the purest water in Florida.

Until recently, underground storage tanks were largely unregulated. But federal law now prohibits the installation of some types of tanks. The U.S. Environmental Protection Agency and many states are developing standards for other tanks—new and old—that contain hazardous substances. The EPA regulations are scheduled to take effect over the next three years.

■ ***January 1986***

Killer Waves

It speeds through the ocean at up to 600 miles an hour. But you can't see it until it reaches shore, where it can ravage coastlines and kill thousands of people.

It's not a secret weapon or a dreaded creature in a horror film. It's a tsunami—a powerful wave that radiates from underwater earthquakes in the Pacific Ocean. Only a few feet high but nearly a 100 miles between crests, a tsunami hides its destructive force until it approaches land. As it nears shore, the surge of water slows down and piles up into a wave that can reach as high as a 10-story building when it hits land.

In Japanese, tsunami means "great harbor wave." In 1896, one of these giant waves killed 27,000 people in Japan. Almost all Pacific Ocean countries have suffered damage from tsunamis.

In 1948, the United States established the Pacific Tsunami Warning System. From Hawaii, the system includes a far-flung network of seismographs to measure earthquakes and tide gauges to report the beginning and progress of tsunamis. A second warning center now operates in Alaska to watch more closely over North America's Pacific shores.

The U.S. government's National Oceanic and Atmospheric Administration has stationed a satellite more than 22,000 miles above the Pacific Ocean that instantly relays warning signals over the entire region. And the United States is helping Chile place monitoring instruments along its coast that will tie into the system.

The tsunami warning network now includes 18 nations and territories that cooperate to alert people to the giant waves before they hit.

■ ***October 1984***

Mussel-bound Oil Rigs

The underwater legs of offshore oil drilling platforms may appear long and skinny. But they do grow mussels.

A small but enterprising company is profitably harvesting mussels that grow on the legs of offshore oil rigs in California's Santa Barbara Channel. These mussels are not the biceps body builders work so hard to develop but the small shellfish that many of us love to eat.

Ten years ago, California biologist Robert Meek saw a business opportunity in the mussels and barnacles encrusting the legs of offshore oil rigs. Oil companies were spending hundreds of thousands of dollars to scrape off the crusty marine growth because its total weight and shape threatened the platforms' stability.

Meek knew that the water was rich in nutrients and cleaner in the Santa Barbara Channel than in the pollution-prone tidal mud flats where most mussels are commercially harvested. Why not scrape these creatures off the oil rigs, he asked, suction them up to the surface and sort out the edible mussels?

The California scientist and his marine research company, Ecomar, were able to persuade Chevron, Phillips, Texaco and other oil companies that it was a good deal all around. But it took several years to convince regulatory agencies that the proposal was environmentally sound and the mussels were safe to eat even though they were growing under an oil rig.

This year Ecomar will sell about 320,000 mussels—three times as many as it sold three years ago. Meek claims his mussels have thinner shells and are sweeter than those taken in shallow water. He sells many to East Coast dealers at premium prices.

Ecomar is experimenting with growing a special Japanese oyster in seed beds suspended from the platform legs. The company's success proves that oil and water technologies *can* mix.

■ ***January 1987***

■ Splash!

Fifty million years ago an asteroid slammed into the ocean, rocking the Earth.

Comets, asteroids and meteorites have left craters all over the Earth's continents. But a team of Canadian scientists recently found the first such crater on the floor of the ocean. Lubomir Jansa of the Bedford Institute of Oceanography says the so-called Montagnais crater in the Atlantic off Canada's east coast is nearly 30 miles across and more than a mile and a half deep. Jansa says the object that blasted open this crater must have been almost two miles wide and traveling at 40,000 miles an hour when it hit.

Jansa says the force of the impact that made the Montagnais Crater 50 million years ago is unimaginable. It packed the wallop of nearly 300 *billion* tons of dynamite.

> *The entire stockpile of atomic weapons right now is about 16,000 megatons. The Montagnais impact had a destructive power about 18 times larger than the total nuclear arsenal.*

The impact was so devastating that it may have helped drive the dinosaurs to extinction. Some scientists believe that millions of years ago, such a crash threw huge amounts of dust and water vapor into the atmosphere, changing the Earth's climate and dooming the dinosaurs.

Jansa and his colleagues are investigating this possibility. They are also thrilled by the success of advanced techniques that used seismic information to reveal the crater, which lies buried beneath sediment on the Atlantic Ocean's floor.

■ ***September 1987***

■ History on the Bottom of the Sea

Pages of the Earth's history lie in thin layers on the ocean floor.

Among the clues to the world's past are microscopic organisms that lived in the ocean and fell to the bottom after they died. John Kutzbach, a University of Wisconsin-Madison meteorologist, says changes in the abundance of these organisms reflect the evolution of the Earth's climate over millions of years. He says scientists read these changes in cores taken from ocean-bottom sediment.

> *Once we get back before a few thousand years ago, we're placing more and more reliance on ocean sediment cores for understanding the Earth's history, because you have a book that's accumulated at the bottom, page by page, which is there to be read.*

Kutzbach is working on a climate research project that analyzes core samples from the floor of the Indian Ocean. Some of the core samples were drilled below more than 6,000 feet of water, and they contain hundreds of feet of sediment dating back as much as 10 million years.

Different organisms thrive in different environments. Kutzbach says the types and abundance of organisms in different sediment layers reveal changes in the oceans' temperatures and nutrient levels. He says these organisms also reveal past air and water currents and indicate the temperature of the prehistoric atmosphere.

> *Since 70 percent of the Earth's surface is covered with ocean, if we understand the Earth's ocean history, we have some pretty good ideas of what's happening over the land surface, too.*

Kutzbach says the Indian Ocean project will help explain climate changes around India, the Himalaya Mountains and the Tibetan plateau—changes that affected climates around the world.

■ ***January 1988***

Acid in the Ocean

Acid rain, a threat to northern lakes, may also threaten the ocean coasts.

Because of the sheer size of the oceans, researchers have commonly considered them immune to the effects of acid rain. But a study by a private environmental research organization indicates acid rain may indeed affect the ocean coasts.

Environmental Defense Fund staff scientist Diane Fisher wrote a recent report documenting damage along the Atlantic Coast in Chesapeake Bay. Fisher says the way acid rain harms coastal waters is unexpected. She says it's not the acid that does the damage.

> *People have sort of assumed that acid rain would not be a problem in the oceans because the acidity in acid rain is not a problem. But the nutrient property of the nitrogen in the acid rain is a problem, and that's what we looked at in our study. The nutrient encourages the growth of algae, which chokes off the water and makes it impossible for anything else to grow there.*

Fisher estimates one-quarter of the nitrogen that enters the bay comes from acid rain generated in part by nitrous oxide, a component of auto exhaust. She says a current Chesapeake cleanup initiative aiming to cut nitrogen pollution by 40 percent will be crucial in limiting the damage. But Fisher notes there is a larger issue.

> *I think that acid rain is a problem not just for a few lakes, it's a problem for our coast, it's a problem for our cities, it contributes to pollution problems there, and I don't think people in any part of the country should assume that acid rain is not a problem for them.*

Fisher says legislation now before Congress could help cut acid rain, taking a burden off some areas hard hit by this pollution from the sky.

■ ***July 1988***

Skimming the Surface

Maybe you can't judge a book by its cover, but you can learn a lot about an ocean or a lake by looking just a few inches below its surface.

These first few inches of water teem with life. Microscopic plants and animals important to the food chain live here along with the eggs and larvae of fish and shellfish. In the Great Lakes, tiny animals near the surface provide food for small fish, such as alewives, which in turn become prey for larger fish sought by sport and commercial fishermen. In the oceans, surface waters play a crucial role for valuable commercial species such as flounders, crabs, lobsters and anchovies.

Changes in the top few inches of water can affect life both above and below the surface. Some scientists believe the impact of pollution on this part of the environment deserves closer study. University of Wisconsin-Madison water chemist David Armstrong has analyzed the pollutants in the surface layer of Lake Michigan.

> *We found that concentrations of metals such as lead, cadmium and zinc were higher in the surface microlayer than they were in the water below, so there is an increase in concentration at the surface.*

Armstrong has learned that a high proportion of the pollutants that concentrate at the water's surface fall from the air. And though other factors exert greater influence over contaminants in the Great Lakes, Armstrong believes this microlayer is still important because it is where many contaminants enter the food chain.

The surface layer accounts for only a small portion of the entire volume of a lake or sea, but it may hold answers to many questions that involve deeper waters. ■ ***October 1984***

■ Scales of Justice

In Connecticut, the scales of justice weigh dead fish.

Industries that dump or spill chemicals into public waters often face heavy statutory fines. Some states have decided this is not enough. In Connecticut, companies that discharge unwanted chemicals into public waters are also fined for fish that die and recreation that is lost because of the pollution.

William Hyatt of Connecticut's Department of Environmental Protection says the extra fines recover more of the actual costs of damage from water pollution.

> *In addition to the fines that are paid because of a violation of law, when a fish kill occurs, there's also a loss to the citizens of the state that results from the kill itself.*

Penalties for fish kills are based on the value of the fish and the number and size of those that die. Hyatt says all species of fish have been assigned a dollar value based on figures from the American Fishery Association. For example, a walleye or a salmon may be worth nearly $3; a trout may be worth about half as much.

When fish die in a chemical spill, says Hyatt, state officials count and measure fish in part of the polluted area. Then they calculate the fine based on the number and average sizes of each species that died. Money that is collected goes into a fund to improve sport fishing in Connecticut.

Hyatt says other states have programs similar to Connecticut's. But he says Connecticut is unique because it also charges for the value of lost recreational time due to chemical pollution.

The state has determined a dollar value for an average fishing trip. Fines for water pollution reflect the number of fishing trips that are lost while a stream or lake is recovering from chemical pollution. Hyatt says this lost recreational value can far exceed that of the lost fish. ■ ***May 1988***

■ Tourists and Toxins

Honeymooners and toxic wastes: Niagara Falls remains popular and polluted.

For tourists, Niagara Falls is one of nature's great spectacles. But environmentalists call it an open sewer full of toxic wastes. That's because the Niagara River, which connects Lake Erie with Lake Ontario, is surrounded by chemical waste dumps. Love Canal is the best known, but many others—hundreds, by some estimates—also leak poisons into the river.

A recent report by University of Toronto scientists said the water pouring over Niagara Falls is laced with PCBs, chloroform, chlorobenzene, and other suspected cancer-causing chemicals. The scientists said the mist kicked up by the cascading water also contained these toxins.

U.S. and Canadian officials deny that Niagara Falls mist poses a threat to humans. And though the Ontario study is not the first warning about Niagara's pollution, the tourist industry there has remained healthy. Marguerita Howe, head of Operation Clean Niagara, an Ontario-based environmental group, says tourists seem unaware of the river's contamination.

> *I wonder how many of them really know a great deal about it. I have a feeling that they don't, and certainly the tourist people in both communities would hesitate to emphasize there is a problem in the Niagara River.*

Although Howe sees irony in the condition of the water that inspires awe in Niagara Falls tourists, her main concern is drinking water. The river is a major source of water for Lake Ontario, where more than five million Americans and Canadians get their drinking water. It is for their sake, says Howe, that government and industry must clean up the Niagara River. ■ ***June 1988***

■ Lake Woes, Begone!

A dash of lime may protect a Minnesota lake from acid rain.

Hundreds of lakes in northern Minnesota, Wisconsin and Michigan are sensitive to acid rain because their water is soft. Soft water lacks the minerals needed to neutralize acid, and this could spell trouble for fish that do not reproduce in acidic water. To protect fish in these northern lakes, scientists are studying the possibility of adding lime—actually, ground limestone—to keep the water from becoming acidic.

Last May, researchers from the U.S. Fish and Wildlife Service and the state of Minnesota sprayed five tons of lime into Thrush Lake, a small trout lake in northern Minnesota.

David Wright coordinates the project for the Minnesota Department of Natural Resources. Wright says lime applications have limited but practical value. They probably will be most useful for protecting special fish populations worth the expense. But he stresses that liming is a short-term remedial action and not the answer to the acid rain problem.

Unlike some lakes in the eastern United States and Canada, lakes in Minnesota do not *yet* show damage from acid rain. No lakes in Minnesota have lost their fish to acidity. However, scientists may have found early *warnings* of acidification in Minnesota's Thrush Lake. They've discovered a plant called sphagnum moss living on the lake bottom. Wright says this was a big surprise for two reasons: First of all, sphagnum moss commonly lives in highly acidic bogs, and second, the moss usually lives above water.

Sphagnum moss itself can make water more acidic. Adding lime to the waters of Thrush Lake may kill the moss, and that, in turn, could improve water conditions for some of the lake's fish and other plant and animal life.

In effect, the scientists are using northern Minnesota's Thrush Lake as a giant test tube. They will be watching their experiment until 1993.

■ ***November 1988***

■ Tomorrow's Trophy

"Catch and release" catches on throughout the country.

There's a growing trend in sport fishing these days called "catch and release." Put simply, if you catch a fish, you turn it loose again—even if it is big enough to eat.

James Addis, director of the Wisconsin Department of Natural Resources' Bureau of Fish Management, explains the reasons behind this trend.

> *Those who catch and release like to release those intermediate-sized fish in the hope that they'll survive, contribute to another day's fishing and also grow into bigger fish which will provide trophies.*

Addis says you can do many things to help a fish survive being caught. Keep the fish in water as you remove the hook and avoid using a net. A net can entangle a fish, hook or line and delay the fish's return to water. If you are fishing from a beach, take the fish away from waves to unhook it because sand can damage fish gills.

Addis says if you must take the fish out of water, keep it level to prevent damage to its internal organs. Moisten your hands or gloves with water before touching the fish and be careful not to rub off its protective slime. Freshwater fish, especially thin-skinned species like trout, are susceptible to skin infections.

Avoid touching the gills or belly when you remove the hook. Then use needle-nose pliers to turn the hook and pull it free. If the hook is deep in the fish's stomach, leave it in and cut the line. In many cases, Addis says, that will improve the fish's chance of surviving.

When you are ready to release the fish, move it slowly through the water first to revive it. If the fish came from deep water, gently plunge it head-first and straight down. This can give a tired fish a boost. Above all, Addis says, common sense and care help fish survive fishing and contribute to tomorrow's trophies. ■ ***July 1987***

■ Scavenging Submerged Souvenirs

Sport divers who pluck souvenirs from sunken ships are plundering our maritime heritage.

David Cooper, a researcher at the University of North Carolina-Greenville, says valuable information about shipping disappears when sport divers remove personal effects and sailing gear from sunken wrecks. Cooper says when these artifacts are taken, archaeologists lose information on the age and condition of a ship, the social status of its crew, and the conditions of shipboard life.

> *There's a lot of information to be gotten off a wreck, and when that stuff is taken away and put on someone's mantlepiece, all that information is lost.*

Cooper is studying a sunken Great Lakes schooner, the *Fleetwing*, which ran aground in 1888 on the shore of Lake Michigan in northeastern Wisconsin. He says such wrecks can provide physical evidence of Great Lakes shipbuilding during the nineteenth century. The sunken remains can yield details about how the industry adapted to certain types of cargo and special problems of sailing on the Great Lakes. In the late 1800s, grain was a major commodity in the Great Lakes region, and the *Fleetwing* may provide clues about how ships handled and carried such cargo.

Cooper has run into the problems of scavenging firsthand. He says his work on the *Fleetwing* is difficult because the wreck has been thoroughly picked over.

> *Most all of the moveable artifacts have been taken from the site: the anchors, the windlass . . . a furniture company even took away two truckloads of material.*

Some states, such as Michigan, have established reserves to safeguard underwater historical sites. And Cooper says sport divers are becoming more aware that scavenging is not a responsible part of their pastime. ■ ***October 1987***

■ Teach Your Children

Parents who introduce their kids to boating should also teach them how to survive on the water.

For some children, boating with their parents is a special part of their lives. But often they do not learn how to handle a boat in an emergency without help.

Dolly Garza of the Alaska Sea Grant program says children should be prepared to fend for themselves following a mishap on water. But the boating safety specialist says some parents assume they will always be around to protect their kids in emergencies.

> *You have parents who don't teach their children how to run the boat or how to put on a life preserver or how to use safety equipment. They assume that they'll always be there to do that.*

Garza suggests that parents teach their children the basics of boating: how to start a motor and run the boat to shore, where to find the fire extinguisher and emergency supplies, and how to use them. Garza also urges parents to show their children how to use the radio to call for help, how to describe the boat and an accident, and how to pick out landmarks to describe the boat's location.

Garza says kids should know how to survive a boating accident on their own.

> *They have just as much chance of finding themselves either stranded because they're lost, or being the only survivor of a shipwreck or a plane wreck. So I feel they need to know just as much as adults do.*

The boating safety specialist also recommends that parents take their children to a pool or beach to practice floating in life preservers and survival suits. Parents sometimes buy the wrong sizes for their children and should make sure the survival equipment fits *before* it is needed. ■ ***August 1987***

■ Handicapped on the High Seas

A special sailing program takes the "dis" out of disabled.

The *Lord Nelson* is no ordinary ship. At first, she looks traditional, reminiscent of old British sailing vessels. At 140 feet and 400 tons, she sports a crow's nest and three masts that fly up to 18 sails. But look closer and you'll notice a network of special harnesses and tracks, electric lifts, even an elevator. And you'll see audio and video equipment adorning the helm. All this enables *disabled* sailors to challenge the high seas.

People who are blind or deaf, and those with polio or other disabilities, can help navigate, maneuver sails and perform daily shipboard tasks. These adventures are just part of the National Ocean Access Project.

Although it focuses on sailing, the project aims to make all water sports accessible to the physically disabled. Its activities around the country include water sports projects on both coasts and on Lakes Erie, Ontario and Michigan.

John Lancaster directs the private, nonprofit venture. Lancaster has sailed the *Lord Nelson* and warns it is not a pleasure cruise. But he adds it can be rewarding for everyone.

> *Disabilities become transparent. Any attitudinal or other barriers that may exist between people with disabilities and people without disabilities soon go away and are forgotten in the joy of the joint project that's before the individuals.*

Lancaster says up to half of the 40-person crew can be handicapped, including eight who use wheelchairs. Any physical disability is acceptable and no experience is required. There's a permanent crew, and Lancaster says the ship meets Lloyd's of London's highest safety standards.

Lord Nelson cruises are quite popular. The ship is scheduled to make a voyage around Great Britain this summer and 10 trips around the Bahamas next winter. ■ ***July 1988***

■ Hanging Ten on Lake Michigan

Grab your board and hit the beach. Surf's up at Sheboygan!

The hotdoggers come from Detroit and Minneapolis, Racine and Ashtabula. When the weather's just right, they stack their boards on top of their cars and head for the surf. No, they're not going to Malibu Beach. They're going to the Indiana Dunes or the long pier at Sheboygan, Wisconsin.

According to the Great Lakes Surfing Association, about 2,000 surfers chase waves around the Great Lakes. Association president Dave Irwin says waves may be better on the ocean, but when the wind blows across the lakes from the right direction, it can stir up waves three to five feet high. Surfers call some of these "mushburgers." They're as high as regular ocean waves, but instead of rolling over, they just crumble when they approach shore.

A good wave on the Great Lakes can carry a surfer about 50 yards, and the best are said to be along the eastern shore of Lake Michigan at Grand Haven, Michigan. In the fall, the air turns cool but the water stays warm, ideal conditions for surfing championships. Dave Irwin says about 100 people met at Grand Haven last September, competing for trophies in the surfing association's annual contest.

Storms often bring the best waves, and storm surfing is popular in the fall and even into the winter. Enthusiasts have been known to don wetsuits and carry their boards over ice along shore to get to the water.

Surfing on the Great Lakes became popular in the 1960s but faded toward the end of the decade. In 1983, Irwin revived the Great Lakes Surfing Association.

He feels there's no comparison between regular board surfing and wind surfing, another popular water sport. In wind surfing, you have to spend time setting up the sails. Board surfing, he says, is just free: You grab your board, run into the water and go. ■ ***November 1988***

■ Sedimental Journey

Much of the upper Mississippi River's abundant wildlife lives in shallow backwaters, but these valuable environments are disappearing.

Backwaters are the transition zone from marshland to deep river. Many were formed 50 years ago when the U.S. Army Corps of Engineers built a string of navigation dams to make the upper Mississippi safe for barge traffic. But Henry Snyder of the U.S. Fish and Wildlife Service in Winona, Minnesota, says silt is filling in parts of the river where the current is weak, and this is especially true in the backwaters.

> *What we are seeing now is the result of 50 years of aging and filling in the backwaters. People are beginning to notice that some of the good fishing spots and some of the good duck-hunting spots now have been filled in. And we just don't have a very good ability to deal with this on a large scale.*

The problem *is* large. The upper Mississippi drains millions of acres of farmland. Snyder says many farms in the drainage area lose more than 10 tons of topsoil per acre a year. In an average year, more than 100 million tons of soil enter the upper Mississippi, and much of it settles in the river's backwaters.

The Fish and Wildlife Service predicts that the backwaters will become marshland within 50 years and dry land within a century. In hopes of saving the backwaters, conservation agencies from five river states have asked the federal government to promote erosion control on farms throughout the upper Mississippi watershed. They fear that without such controls, the river will lose its most biologically productive areas and the fish, waterfowl and other wildlife they support.

■ ***April 1985***

■ The Soldiers Grove Solution

Wisconsin's Kickapoo River has been both bane and blessing to the communities situated along its banks. The first settlers in the Kickapoo Valley used the river to power mills, and towns eventually grew around the milling centers. But the Kickapoo, located in southwestern Wisconsin, has never been a tame river. Periodically, it jumps its banks and floods towns like Soldiers Grove.

Although plans to control the course of the Kickapoo had been kicked around since the 1930s, none had been carried out. By the mid-1970s, it was clear something had to be done. Tom Hirsch, former community development coordinator for Soldiers Grove, says the town's residents had several choices.

> *There were three alternatives, and these were discussed at some length in planning documents as well as in environmental assessment. And they boiled down to three choices: do nothing; the structural solution, which is, as the Corps of Engineers had envisioned it, earthen levies and some channelization—deepening the channel so that it could carry more water through Soldiers Grove; and the so-called nonstructural solution, which was to remove the people and their property from the floodplain of the Kickapoo River.*

The 500 people of Soldiers Grove, after much debate, settled on the last alternative. Hirsch says the decision to move the town a quarter-mile from its original location was unique. Most often, *rivers* are moved, not *people*.

Today a new Soldiers Grove sits on high ground, away from the temperamental but unmolested Kickapoo. Although not the solution for every flood-plagued town, relocation could become an accepted alternative to dams, levies and dredging. ■ ***November 1983***

The River's Keeper

Along the Delaware River, Cynthia Poten is known as the river keeper.

The sound of bulldozers is becoming more common along the pristine reaches of the upper Delaware River in New York, Pennsylvania and New Jersey. It means new homes and new shopping malls. To Cynthia Poten, it also means new threats to the upper Delaware's clear water.

Poten works for the American Littoral Society, a national nonprofit organization founded to conserve coastal waters. Her job title is river keeper, and her duty is to watch over the river's health.

For the past year, Poten has kept an eye on potential threats to the 300-mile-long Delaware. Two of her biggest concerns are pollution by toxic chemicals and diversions of water to New York City.

Poten's days are often as long and winding as the river itself. Some days, she meets with citizen groups to talk over new ways to treat sewage in developing areas. Other days, she works with attorneys to fight a plan to fill one of the Delaware's wetlands. And, on occasion, she gets in her canoe to collect water samples from the river for testing.

Poten considers the river inseparable from the surrounding streams and countryside.

> *The river is a living water system. The smallest tributary eventually becomes the Delaware River. All of these waters that flow together and eventually flow into the river are threatened by numerous problems.*

Other river keepers are at work around the country. In New York, for example, private groups employ river keepers to monitor the Hudson River and Long Island Sound.

River keeping is not Poten's only job. She also runs a small garden business. She has no formal scientific training, but she feels strongly that *everyone* is responsible for protecting the environment. She says government agencies may be well-intentioned, but they are often handicapped by politics and can do only part of the job. ■ ***December 1988***

The Irrigation Nation

Israel waters its crops more efficiently than any other nation in the world. It needs to. According to Sandra Postel, a researcher for the Worldwatch Institute in Washington, D.C., the tiny country hasn't a drop of water to spare.

> *Israel is using about 90 to 95 percent of its supplies. The Israelis have essentially no additional fresh water to tap to augment their supplies, so they are in a situation where they have to find ways to increase water efficiency if their economy is going to continue to grow and if they're going to continue to expand irrigation for food production.*

Israel moved rapidly from ancient farming methods to high-technology agriculture. Postel says advanced systems like drip irrigation help Israel's farmers deliver just the required amounts of water rather than flood their fields.

Israel has a strict government allocation system to encourage efficient irrigation. The government estimates how much water a crop needs and charges stiff fines if a farmer uses more.

Farmers have used computer-controlled irrigation systems and high-yield, salt-tolerant crops to produce more with less water. A gallon of water yields twice as much food and fiber today as it did 30 years ago. This lets Israel meet most of the agricultural needs of a population that has grown from 800,000 in 1947 to about 4 million now.

But Israel is still pushing the limits of its resources. Irrigation water becomes more and more salty as it's reused. Israeli officials estimate that by the end of this century, half of their country's irrigation water will have to pass through purification plants before it's used on anything but salt-tolerant crops. ■ ***May 1985***

■ Fresh Water from the Sea

Most of us take water for granted. We can turn on the tap any time we want and get a drink or wash our hands. But until about 15 years ago, that simple act was a luxury for the people of St. Thomas in the U.S. Virgin Islands.

Lying 1,200 miles southeast of Florida, St. Thomas is a Caribbean island rich in natural beauty but very poor in fresh water. Historically, the islanders have gotten their water from brackish wells or from cisterns that store the rainwater that runs off the roofs of their houses.

Over the past few decades, though, tourism on St. Thomas has exploded, creating a need for more reliable supplies of water. To solve this problem, the islanders have turned to the water that lies all around them: the salt water of the Caribbean Sea.

In 1981, Aquatech—an Israeli firm—built one of the largest desalination plants in the Caribbean region on the island of St. Thomas. According to technician Hanan Rosbruch, the Aquatech plant separates the salt from seawater using a steam distillation process and waste heat from the St. Thomas power plant. The salt, diluted in seawater, is pumped back into the ocean.

Rosbruch says the plant can produce about 2.5 million gallons of fresh water a day. To the islanders, that water's worth about $100,000.

Because the plant is constructed mainly of plastic piping, it won't deteriorate from the corrosive seawater and fall apart. Only a few years ago, that's what happened to St. Thomas' first desalination plant.

Rosbruch says his plant is economical and very easy to maintain. Best of all, the islanders and tourists on St. Thomas can turn on the tap any time and get fresh water from the sea.

■ *May 1983*

■ Thirst Aid

Water is a scarce commodity in the growing cities of the desert Southwest. So scarce, in fact, that wastewater in El Paso, Texas, is too valuable to throw away.

El Paso, with half a million people, is the first big city in the country to pump treated sewage back into its underground water supply so it can use the water again. The city has just opened a unique water recycling plant to make it possible.

Local water utility official Robert Bustamante says the recycling plant turns out much cleaner water than conventional waste treatment plants.

> *We have to go through much more intense treatment. There are many more stages in this particular plant than in a sewage plant that discharges effluent into a river or lake.*

El Paso's water recycling plant can purify 10 million gallons of water a day. That's enough to meet 10 percent of the city's needs. And Bustamante says the plant will prolong the life of the city's main water source.

> *Right now, we're getting the majority of our water from an underground source that is being depleted: We're extracting more water out of the groundwater aquifer than what nature is replenishing, so we're mining this particular source. This plant is going to slow down that depletion; it's not going to eliminate it.*

The Texas city is stretching its water supply in other ways. City reservoirs are lined with plastic to prevent leaks. Many residents are landscaping with native plants suited to the desert climate. And water is priced to encourage conservation.

But even all those things won't slake the city's thirst if El Paso keeps growing, and local officials are eyeing new, untapped water sources in New Mexico for the future. ■ *July 1985*

Leaky Pipes

The water supply systems of many American cities need costly repairs. But changing attitudes about water use may be just as important as fixing pipes.

About 10 years ago, engineers discovered some of the water pipes still used in Boston were made of wood and were installed at least 150 years ago. Those old pipes are a sign of a problem that faces many older eastern cities like Boston: Their water supply systems need massive overhauling.

The Freshwater Foundation estimated that Boston lost 20 percent of its water through leaky pipes in 1983. The U.S. Army Corps of Engineers reported in 1980 that one-fifth of the nation's larger cities required replacement or restoration of their water supply systems. The Army Corps estimated this would cost between $50 billion and $80 billion over the next two decades.

The big question, according to James Crewes, a civil engineer with the Army Corps, is this: Who is going to pay for revamping those water supply systems?

> *The major issue is: Should it be done by federal dollars, or should federal dollars help, or should it be done by nonfederal? Of course, the administration's policy is that water supply is a nonfederal responsibility.*

Crewes says many states, like Massachusetts, are solving water problems with new laws and public information campaigns that promote conservation. For example, Boston's successful "Use Less Water" campaign provides educational materials about water conservation to schools and grants for innovative water-saving devices.

Such efforts, Crewes says, are needed to help raise public awareness about water supply and conservation issues. They also will help make the public cost of replacing the 150-year-old wood pipes easier to accept. ■ ***September 1985***

Not a Drop to Drink

Enough water falls to earth as precipitation each year to support more than five times the present world population. Yet people still suffer from lack of water. Why? Mostly because some regions enjoy an abundance of water while others go thirsty.

Sandra Postel of the Worldwatch Institute recently examined the global water supply, and she predicts dry times ahead for much of the world. Postel says farmers account for about 70 percent of the world's water consumption, and they already face shortages. The Soviet Union provides one example.

> *The Soviet Union has the problem that most of its water is in the northern and eastern parts of the country, but most of its people and the best land for agriculture are in the southwestern part of the country. The Soviets have developed the supplies in the southwestern part of the country almost to their limit, so that in many dry years, all the water resources in that region are essentially used up.*

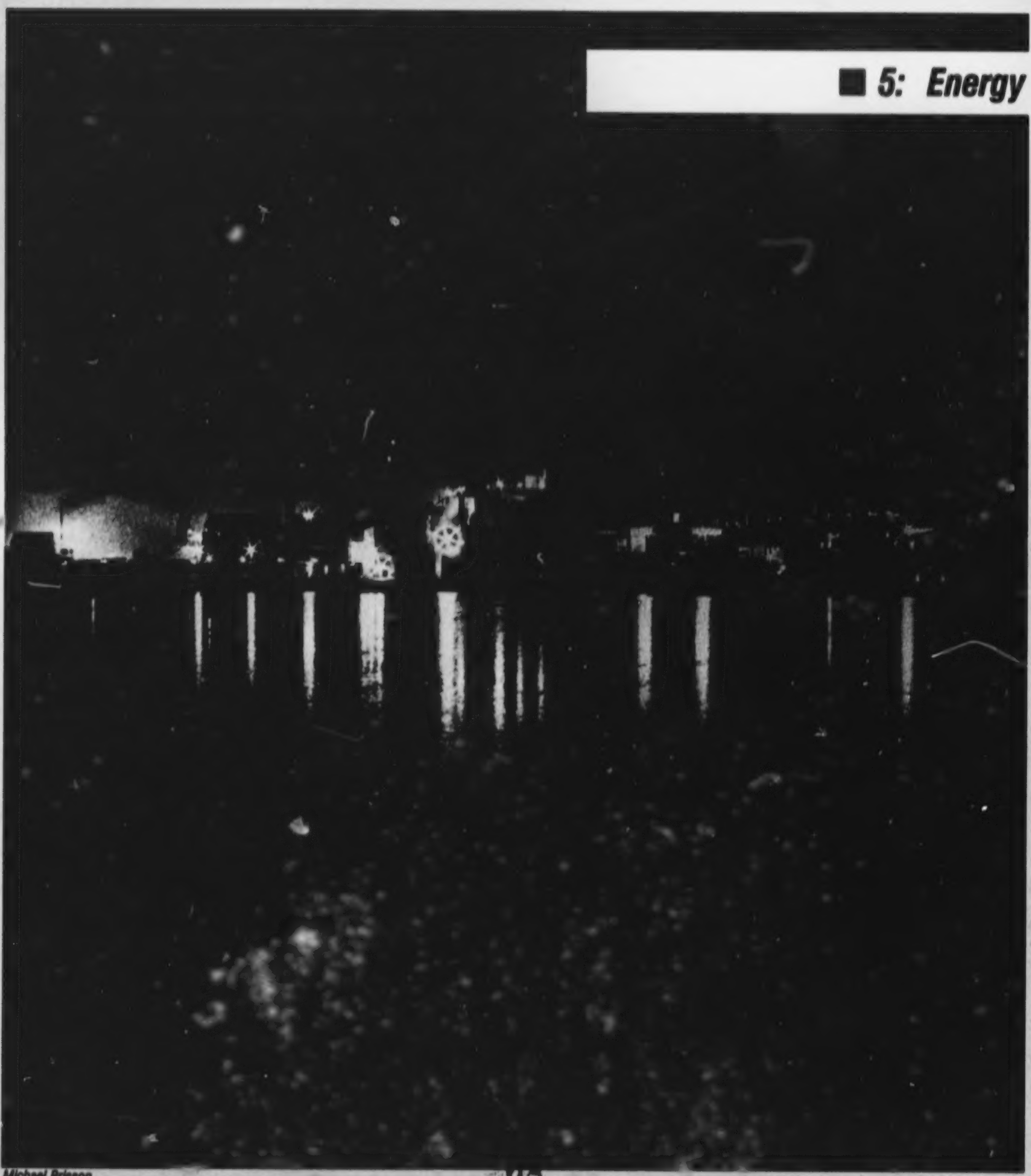
Postel says many American farmers will also need new water sources sooner or later.

> *In the United States, for example, in the high plains area, which includes a lot of Midwestern states, farmers have been relying for several decades now on water from the Ogalalla aquifer, which is essentially a nonrenewable water resource.*

In regions not blessed with much water, Postel believes shortages will be severe within 15 years. She says North Africa and the Middle East will need every drop of their usable water by then. Parts of Europe and Asia will also tap nearly all of their reliable water supplies. Unfortunately, she says, pollution and poor management will make those supplies even more scarce than they are now.

■ ***February 1985***

■ 5: Energy



Michael Brisson

Bright Ideas

Light bulbs use a quarter of the electricity generated in the United States, according to the Electric Power Research Institute (EPRI) of Palo Alto, California. The institute also claims that half of the 420 billion kilowatts a year used for lighting could be saved.

Conventional incandescent light bulbs waste 90 percent of the energy they consume, yet incandescent bulbs remain the most popular bulbs sold because their warm light makes people, rooms, and foods more attractive. But recent improvements in fluorescent and arc lamps have softened those types of light and given them more pleasant, rosy auras. The news is welcome because fluorescent and arc bulbs are five to six times more efficient than incandescent bulbs.

The business world is paying attention to the costs of lighting, and rightly so. EPRI says lighting can account for 10 to 50 percent of a business's electricity costs. Some businesses are replacing overhead lights with desk lamps. Others are switching to lamps coated with super-reflective films that boost lighting efficiency by 15 percent.

And that's just the beginning. The research institute says buildings designed to capture sunshine can cut back on electric bills. They can even use sensors to adjust electric lights as the natural light brightens or dims. Timers can switch lights on when people arrive for work and off when they leave. Some devices know which rooms to light by detecting the presence of people. The most sophisticated systems operate by computer, maintaining not only lights but also heating and cooling equipment for entire buildings at the most comfortable and efficient levels.

EPRI says each time something clicks off, the energy saved helps reduce the demand for new power plants and helps hold down the future cost of electricity. ■ ***October 1984***

Window Breakthrough

Windows are notorious for losing heat in winter. But a new type of glazing makes some windows a lot stingier.

Glass manufacturers predict a bright future for a metal-oxide window glazing that keeps heat indoors when the mercury drops outdoors. It's called low-emissivity coating, or "low-e" for short.

Roger O'Shaughnessy, president of Cardinal Insulated Glass of Minneapolis, says depending on the direction they face, most low-e windows actually gain more heat than they lose.

> *Windows with low-e coatings will be energy-positive in all areas of the country, including the very coldest areas, on three elevations: east, south and west. The north side windows with these improved glazings get close to neutral, but they are still somewhat energy-losers in the very coldest part of the country.*

Low-e windows let most sunlight shine in from outside but trap up to 90 percent of the heat that tries to escape. By comparison, uncoated glass traps only a third of that heat.

A double-pane, low-e window insulates as well as a triple-pane conventional window and costs about the same, but it's lighter in weight and lets in less of the ultraviolet light that fades furniture and carpets.

O'Shaughnessy says low-e windows, which hit the market just a few years ago, are becoming a best seller.

> *Within the next five years, I would expect that 75 percent of all the windows produced in the northern climates, perhaps more generally in the wood-window industry, will be converted over to low-e.*

Glass manufacturers say low-e windows are best suited for homes and small commercial buildings. ■ ***January 1986***

A Better Idea?

The average car gets just a fraction of its potential gas mileage, partly because of the way its transmission and brakes work. The transmission has only a few settings, or gear ratios, that allow the engine to work at peak efficiency. And the brakes, whenever they're applied, literally burn away the energy that got the car moving.

A University of Wisconsin-Madison professor says it doesn't have to be that way. Andrew Frank, an electrical engineer, has fitted a conventional car with two mechanisms he claims can double the car's mileage.

The first is called a continuously variable transmission. It pumps oil through the motor to turn gears much as flowing water turns a mill wheel. The transmission has an infinite number of gear ratios, so the engine always runs at peak efficiency.

The second modification is a flywheel that acts as a sort of mechanical battery. It stores energy normally lost during braking. Stepping on the brake engages the flywheel, which starts to spin as its resistance slows the car. To accelerate, the driver steps on the gas pedal. That diverts the flywheel's spinning momentum back to the tires and helps send the car on its way.

Frank says his redesigned car is extremely efficient. It also pollutes less than standard cars. And it's quieter because it can run, at times, solely off the flywheel with the engine turned off.

Frank is road-testing a prototype of his modified car now. He hopes to have an improved model out later this year. Whether his creation ever reaches the consumer market is up to Toyota of Japan, which paid for his research. Frank says no U.S. car makers were willing to put up money for his project, so any patents that result from the research will belong to Toyota. ■ ***June 1983***

Poolside Chat

Jump in, relax, and enjoy the pool. More than 900 employees of the state of Wisconsin do just that every weekday on their way to work. The pool they jump into is a vanpool organized by the state to save fuel, ease traffic and parking congestion, and encourage other Wisconsin employers to try ride-sharing.

Besides the expected benefits of vanpooling, the state is also getting workers who are more ready to do their jobs, according to vanpool coordinator Steven Heidt.

> *The people feel more relaxed upon coming to work—less strained and more comfortable in the job setting. That's an intangible that's hard to measure, but that's a benefit not only to the employee but also to the employer.*

And the state gets these benefits for free. Heidt says all 68 state vanpools in Wisconsin are paid for by the people who use them.

> *There is no taxpayer money coming directly into the program. The fares that are charged to the passengers by state statute have to pick up the total cost of purchasing the vehicles, supplies for the vehicles, insurance, parking costs, administrative costs.*

Heidt says the riders don't mind paying their own way. In a recent survey, vanpool participants estimated that they save half of what they would have spent driving their own cars to work. Heidt says most people underestimate the costs of commuting, and he thinks vanpooling actually saves riders much more than they realize.

Either way, the participants get their money's worth. And they also have a voice in the operation. Heidt says some riders have asked for air conditioning, AM-FM radios, and deep-tinted windows, and the state has tried to comply. After all, he says, vanpooling ought to be fun as well as practical. ■ ***January 1985***

■ Looks Good on Paper

It took more than 34 million barrels of crude oil to turn the wheels of industry in Wisconsin last year. Nearly 40 percent was consumed by pulp and paper companies, making them by far the largest industrial user of energy in the Badger State.

That percentage might be even higher except that the state's paper makers, who lead the nation in production, have also become leaders in energy conservation.

Thomas Schmidt, executive director of the Wisconsin Paper Council, says it takes 14 percent less energy to produce a ton of paper today than it did a decade ago. With the state's paper mills producing more than ever before, the savings—in both energy and dollars—add up quickly. At the heart of it all, says Schmidt, are several innovations.

> *I think perhaps the most obvious one is technological change, whereby the industry has improved its manufacturing processes to reduce the cost of energy, the use of energy. Secondly, the industry is conserving energy by burning more waste fuels, such as bark and chips that are not being used to make pulp, and we're also consuming some of our spent pulping liquors.*

The results are impressive. In 1972, Wisconsin paper makers had to buy more than 80 percent of their fuel. That figure has shrunk to 71 percent. Schmidt says the companies supply the other 29 percent themselves.

> *That, to me, is a tremendous accomplishment, and it has a positive impact: Not only does it conserve our natural resources, but it also is a cost-effective way to operate a particular mill.*

For the paper industry, says Schmidt, energy conservation is good business. ■ ***April 1983***

■ Udder Delight

The Baumgartners of Owen, Wisconsin, have a warm spot in their hearts for their dairy cows. In fact, their whole farmhouse stays nice and warm thanks to the cows—and a clever heating system with a catchy name.

It's called a Dairy-Air.

Dairy-Air uses heat from cows to warm homes, and the Baumgartners were the first farmers to try one. Their system began as an experiment. Marge Baumgartner and her husband were looking for a way to keep their barn cool and dry because too much heat and moisture were making their cows sick.

> *Our main reason for putting it in was business-oriented more than home-oriented because we had pneumonia problems due to the moisture. It was originally a pig barn, converted into a dairy barn, and we had low ceilings and a lot of calf loss, a lot of mortality, due to pneumonia.*

Baumgartner mentioned the problem at work, and her boss, Del Lussenden, saw a chance to try an idea. Lussenden had some heating and cooling know-how, and he built a system that worked something like a refrigerator. It pulled heat and moisture out of the barn, saved the heat, and piped it to the farmhouse.

The Baumgartners were delighted. Marge Baumgartner says the cows grew healthier, and the house, cozier.

> *The house was warmer than it had ever been since we'd owned the farm, which was about 10 years, and we had tried wood heat and natural gas before.*

Lussenden patented the system, and he is installing more Dairy-Airs. Each must be custom built, but if the Baumgartners' enthusiasm is any measure of its prospects, the Dairy-Air is something a lot of farmers will warm up to.

■ ***November 1983***

Dust to Ashes

A Wisconsin company turns farm waste into a source of cheap energy.

Midwestern grain elevators produce mountains of dust while handling oats, corn and other crops. That dust, mostly tiny bits of seed hulls, is usually dumped into landfills. Occasionally, the dust-filled air inside a grain elevator ignites and explodes.

Robert Norlin, operations manager for the National Energy Corporation of Humbird, Wisconsin, says those tragic explosions demonstrate the energy locked up in grain dust. His company is capitalizing on that energy. It compresses the dust into fuel pellets that industrial boilers can burn. The pellets cost 40 percent less to burn than natural gas. Norlin says his fuel is still more expensive than coal, but it has environmental advantages that coal lacks.

> *It has about one-tenth the sulfur that coal or other fossil fuels do, and so it does not contribute to the acid rain problem.*

Grain dust is abundant in the Midwest. Elevators in the Twin Cities area alone produce about 70,000 tons of it each year. Norlin says that's the energy equivalent of eight million gallons of fuel oil. He says if compressed grain dust pellets catch on as fuel, it could be the start of something big.

> *There are a lot of waste products that can be densified by this same process: waste paper, corn cobs, corn stalks, that type of thing. We're a very wasteful country, and all of those things can be converted into good fuel.*

Norlin says putting those wastes to good use would help make Midwestern states, which import most of their energy, more self-sufficient.

■ ***January 1987***

Cold Facts for the Hot Tropics

Ah, the tropics! Some call it paradise, where ocean waters stay luxuriously warm all year long. But deep beneath the surface, water temperatures are much colder.

This contrast in temperatures has been put to work in Hawaii as an energy resource called OTEC. OTEC stands for Ocean Thermal Energy Conversion, a system for turning the seawater's thermal energy into electricity.

An entire OTEC system can be housed in a floating offshore power station. Raymond Tabata, University of Hawaii Sea Grant scientist, says OTEC works by using warm seawater to evaporate a liquid, such as ammonia, into a gas. The gas turns a turbine and generator to produce electricity. Cold seawater is drawn up from the depths through a large pipe and used to condense the gas back to a liquid. The seawater is then recycled.

Tabata says the beauty of OTEC is that its power source, the solar energy that is stored in seawater, is unlimited and nonpolluting. That means OTEC power could reduce the need for tropical islands to import fossil fuels.

But a few clouds lie on OTEC's horizon. The floating power stations are vulnerable to damage from wind and waves, and OTEC's large pipes and equipment are expensive. Also, scientists are not sure of the environmental consequences of mixing cold and warm seawater on a large scale.

But Tabata believes OTEC's problems can be ironed out with additional research. He says a major advance in years ahead will be the construction of large power plants on shore, eliminating the problem of operating them on the water. He expects the U.S. government will continue to support OTEC in the future. ■ ***March 1982***

■ Future Generations

Nuclear engineers push a new generation of commercial reactors.

If nuclear power has a future, say industry experts, it lies in new reactor designs. They say the current generation of so-called light-water reactors is at a dead end. The reactors are complicated, costly and hard to operate. Utilities have not ordered any for years and do not plan to.

Nuclear engineers say new reactor designs solve the safety and technical problems that have plagued the nuclear industry. They're simpler, and they rely more on automation and computers, less on human operators. Some are updated versions of light-water designs, others are radically different in their safety and fuel systems.

These models also tend to be smaller than most current reactors. Engineers say several small plants would be easier to maintain than a single large plant, and less production capacity would be lost if one broke down. The result of all this, they say, will be safer, more efficient and less expensive nuclear power.

But University of Wisconsin-Madison energy expert John Steinhart has reservations about the new reactor designs.

> *Certainly on paper and while being envisioned they appear to avoid some of the difficulties that we have experienced in Three Mile Island, Chernobyl, and some of the other near misses. But whether that satisfies all of our problems is difficult to say. You build the things and then you find out what it was that you had not anticipated.*

Steinhart is not convinced that more nuclear plants are needed. He says other options, such as solar energy, could probably meet future electricity needs. But he says we cannot know for sure how *any* new technology will perform until it's been around a while. ■ ***August 1988***

■ Quest for Fuel

The first trickle of oil reached the southern end of the Trans-Alaska Pipeline in the summer of 1977. Since that time almost a fifth of all domestic oil has come from Alaska's North Slope. That total may soon climb higher.

Engineers from several major oil companies are eyeing deposits of oil and natural gas that may lie under the Arctic Ocean off Alaska's north coast. Geologists estimate that 40 percent of the remaining undiscovered oil and gas in U.S. territory is in the Arctic Ocean, one of the most inaccessible places on Earth.

The problems of oil and gas exploration in the far north are staggering. Summer there is short. Many ocean sites are free of ice for only two months a year. Winter, of course, is legendary: Temperatures can dip to 80 degrees below zero, and the midday sun barely tops the horizon.

But to engineers, the biggest problem facing Arctic oil drilling is ice. Winter pack ice precludes the use conventional offshore drilling platforms, so oil companies have developed new methods to tackle the problem. In some locations they have hauled tons of rock out over the ice in winter and dumped them through large holes to create artificial islands on which to build drilling rigs. In deeper water, where island-building is out of the question, drilling barges that ride over ice and conical platforms that divert ice around them have been proposed.

The economic problems of drilling in the Arctic are enormous, too: It can cost 30 times as much as exploring for offshore oil in the Gulf of Mexico—some $50 million per well. One test site at Harrison Bay, Alaska, cost an estimated $140 million. It became the most expensive *dry* well in history.

■ ***August 1984***

■ Hawkeye Hydro

Hydroelectric dams were a common sight in Iowa a few decades ago, but only six are now operating in the state. That may soon change. There's new interest in Iowa's hydroelectric potential, and dozens of idle dams may come to life again.

The Iowa legislature passed a law in 1983 encouraging the development of renewable energy resources. The law requires electric utilities to buy electricity from small hydropower plants at a price the state commerce commission deems fair. That may make hydroelectric power economically feasible once again at several old dams.

Larry Bean of the Iowa Energy Policy Council says developers are looking seriously at 39 sites around the state. If all of them were returned to service, their total electricity output would equal no more than that of a small coal-fired power plant. Still, Bean says hydroelectric development could contribute significantly to the state's economy. He estimates construction projects could total $250 million, and the refurbished plants could generate $60 million worth of electricity each year.

There are environmental benefits, as well. Hydroelectric energy is clean and renewable. And because the dams are already in place, little disruption of farmland or wildlife habitat is expected.

Still, some questions have been raised. The Upper Mississippi River Conservation Committee, an interstate organization of natural resource agencies, is concerned about how hydroelectric development could affect fish migrations and river currents. Because several of the dams being considered are on the Mississippi River, the conservation committee is urging further study of the possible impacts before Iowa issues any construction permits. ■ ***January 1985***

■ Carrying the Fire

How to contain a fire that's hotter than the sun—that's a problem for scientists seeking to harness the enormous power of nuclear fusion.

Nuclear fusion could one day provide a safer form of nuclear power. But fusion still faces extraordinary technical obstacles.

A fusion reaction can proceed only if the fuel is kept at temperatures of millions of degrees—hotter than the surface of the sun. But matter that hot reaches a bizarre physical state known as plasma. It's difficult to contain because it vaporizes anything it touches. Scientists hoping to develop a successful fusion reactor must find a way to control plasmas while maintaining their extreme temperatures.

University of Wisconsin-Madison physicist Clint Sprott says powerful magnets can hold plasma away from the walls of a fusion reactor. But the electricity used to keep the plasma hot creates problems.

> *When a current is passing through it, an electric current, it behaves in quite a similar manner to a garden hose with a current of water flowing through it. It will thrash around and ultimately strike the walls of the reactor vessel and lose its energy.*

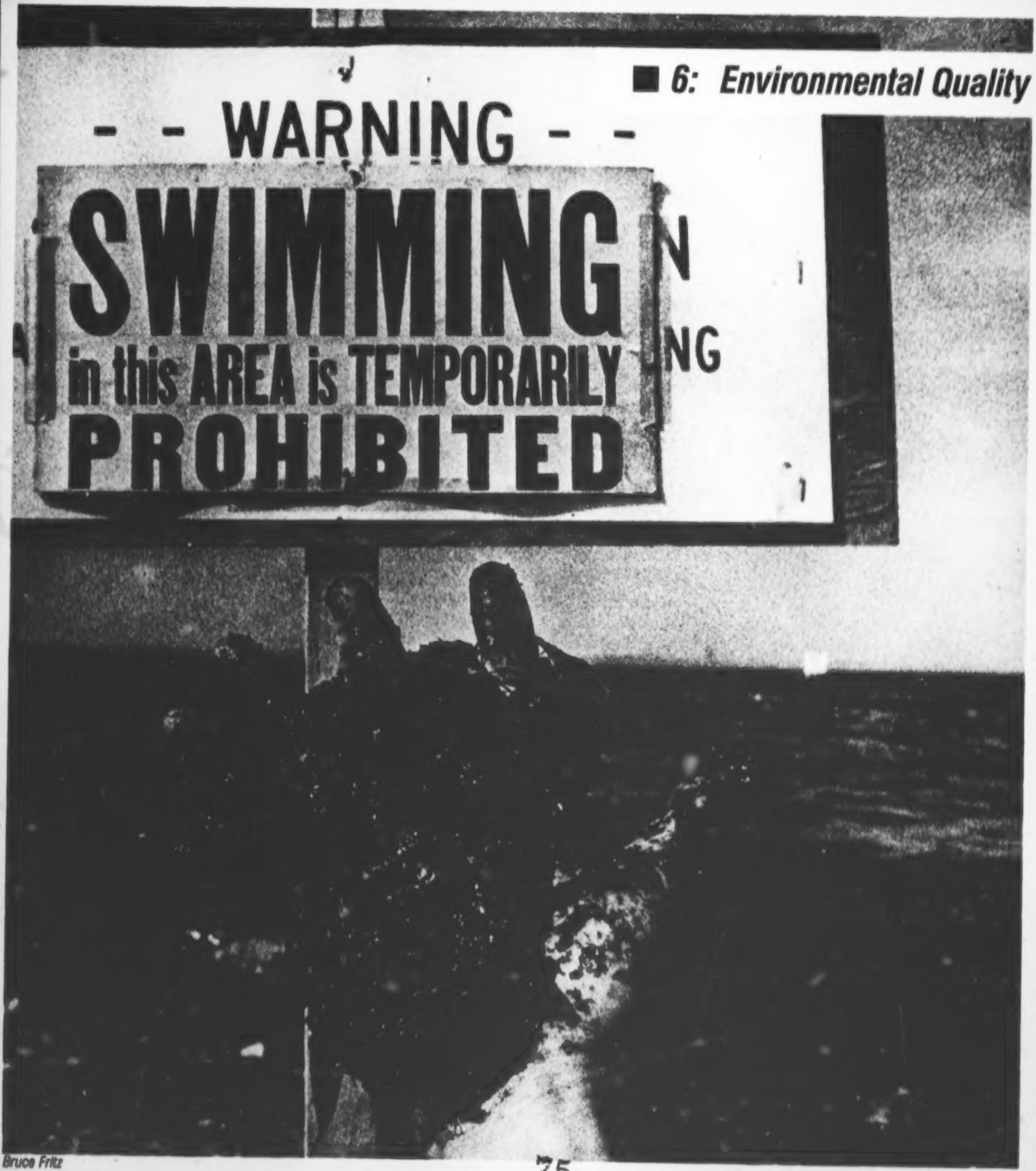
Sprott is looking for ways to heat plasma without making it so unstable.

> *One general way of heating plasmas is with the use of radio frequency power, electromagnetic waves in the radio frequency or microwave range. One can in fact heat a plasma very much like you would heat a turkey in your microwave oven.*

Fusion scientists are slowly overcoming such technical obstacles. But each advance turns up more problems, and the fusion research programs's latest goal—building an experimental reactor by the year 2000—may be a long shot.

■ ***March 1987***

■ 6: Environmental Quality


- - WARNING - -
SWIMMING
in this AREA is TEMPORARILY
PROHIBITED

Bruce Fritz

■ Once Upon a Time

Environmentalists who long for the good old days don't know their history.

There is nothing new under the sun, including air and water pollution. Don Bronkema of the U.S. Environmental Protection Agency says air pollution dates back more than 2,000 years. An ancient Egyptian wall painting, for example, shows officials ordering people to douse their smoky fires. Bronkema says early England also had pollution troubles. Coal fires were a particular source of royal displeasure.

> *The first complaints about coal appeared around 1435 or 1450 during the reign of Edward the Fourth. Coal fires were, by then, so common and there was such a pall of pollution hanging over London that the king himself complained about it.*

Trash disposal has also caused discomfort and illness for centuries. Just 200 years ago, people dumped garbage and human waste out the nearest window. Europeans carried umbrellas to protect themselves from the rain of waste. And as cities grew, so did the amount of trash. Garbage heaps fed rats. Along with the rats came fleas, which carried bubonic plague. Half the population of Europe died of plague in the 14th century.

Bronkema says careless waste disposal also polluted drinking water. In 19th-century England, typhoid from bad water killed half of all babies before their first birthday. The Victorians finally put in sewers, which cleaned up the streets but polluted rivers, including the Thames. Bronkema says the stench nearly caused political chaos.

> *They had to hang huge sheets soaked in lime over the windows of the houses of Parliament so they could complete their budgetary deliberations, and on more than one occasion, too.*

Environmentalists might do well to remember a little history. Nostalgia isn't what it used to be.

■ ***October 1988***

■ Not-So-Clean Industry

The industrial states of the upper Midwest are eager to fill the gap left by the decline of the "smokestack" industries that were their economic backbone for decades. Politicians and business leaders are especially interested in luring high-technology industries, the sort that have blossomed in suburban Boston and in California's Silicon Valley.

Among other things, high-tech industries have a clean image. Most of them operate out of tidy laboratories in park-like surroundings. But it seems no industry is free of environmental problems. That goes for high-tech too. In Silicon Valley, the home of dozens of microelectronics firms, groundwater pollution and worker health problems have cropped up. They've been traced to hazardous chemicals used to make computer chips. Some of these chemicals have leaked out of waste-storage tanks into local water supplies.

Another high-tech enterprise, biotechnology, has not caused environmental problems yet. But some scientists fear it could as the industry grows. Genetic engineers are developing new forms of life—like bacteria that turn hazardous wastes into harmless substances. The fear is that if organisms like these got loose before they were fully tested, they might do more harm than good. What's more, they might reproduce rapidly, with drastic results.

The U.S. Environmental Protection Agency is considering regulations on biotechnology to prevent anything like that from happening. The trouble is, the industry is new and unique, and nobody knows what kinds of regulations it needs. High-tech industries do, indeed, hold promise for the future, but appearances can be deceptive. They may be gentler on the environment than smokestack industries, but they aren't necessarily squeaky clean.

■ ***October 1983***

■ Household Hazards

Your bathroom, kitchen and garage are all familiar places that may hold hazardous wastes.

Caution! Warning! Danger! Federal law requires manufacturers to put these warnings on the labels of products harmful to people. But these warnings are not always marked on the labels of products harmful to the environment.

Elaine Andrews, environmental educator with the University of Wisconsin-Extension, helps communities dispose of hazardous household wastes. She says pesticides, unused paint, flammable solvents, old mothballs and even nail polish all contain chemicals that may contaminate the environment if flushed down the drain, buried or burned. But Andrews says many people dispose of hazardous chemicals this way.

> *Different groups have done studies to find out how people dispose of hazardous materials from their homes. And one of the things they found is that depending on the disposal method, 15 to 25 percent of the people throw their stuff away somewhere besides the garbage can. In other words, they dump it in their back yard, they dump it down the storm sewer, they bury it or they burn it.*

Andrews says three categories of household products require special disposal: those that kill, such as herbicides, flea collars and mosquito sprays; those that dissolve, such as oven cleaners, spot removers and degreasers, and those made of petroleum, such as oil-based paints and motor oil. The chemicals in these products can kill living organisms and contaminate groundwater.

Andrews suggests buying one product and using it for many jobs or buying only what you need for the job at hand and sharing unused chemicals with neighbors. She strongly recommends community drives to collect unused household hazardous wastes and hiring professionals to dispose of the wastes properly. ■ ***April 1987***

■ Punchless PCBs

Taking the punch out of PCBs: Scientists find new ways to detoxify this hazardous waste.

Polychlorinated biphenyls—PCBs—were widely used, especially in electrical equipment, before they were banned in 1976. Of the 1.4 billion pounds of these toxic chemicals produced in the United States, roughly half has escaped into the environment. PCBs are extremely persistent, and exposure to small doses may contribute to a variety of health problems in people and animals.

Cleaning up PCB-contaminated sites is a logistical and financial headache for government agencies like the U.S. Environmental Protection Agency. More than a hundred different public and private research efforts are now under way to develop new, economical methods of detoxifying PCBs. This process is called dechlorination.

The problem with PCBs lies with the C—the chlorine component—which makes the substances highly toxic. Chlorine attaches to PCB molecules in different ways. Some arrangements are more toxic than others and some are easier to break up or dechlorinate.

Scientists at General Electric discovered that bacteria on the bottom of the Hudson River in New York were munching on PCBs and converting them to less-toxic compounds. They are now breeding the bacteria to develop a strain that could help break down PCBs. Elsewhere, scientists at West Virginia University are using sunlight to help dechlorinate PCBs. And at the University of Connecticut, researchers use ultrasound waves to mix PCBs with dechlorinating chemicals.

Which, if any, of these new methods may have large-scale applications is not yet known. But the race to be a market leader in the multibillion-dollar toxic cleanup industry may yield cheaper, safer ways to dispose of a big problem.

■ ***February 1988***

■ Costly to the End

How do you permanently dispose of a used-up nuclear power plant? So far, no one knows.

Safety concerns, waste disposal questions and construction cost overruns have all but doomed the U.S. nuclear power industry. No American utility has ordered a nuclear plant since 1979. Now a new problem looms for the industry and for policy makers: what to do with existing plants once their usefulness has passed.

Cynthia Pollock of the Worldwatch Institute, a Washington, D.C., research organization, says retired nuclear reactors present special disposal problems.

> *When you tear apart a reactor, you get contaminated concrete and steel that has to be isolated, most of it for several decades, some of it several hundred years. But you get very large volumes: 18,000 cubic meters for each 1,100 megawatt plant. That's enough to bury a football field under 12 feet of radioactive debris.*

There are about 100 licensed nuclear plants operating in the United States, and many are nearing the end of their 30-year life spans. Pollock says no major commercial nuclear plant has ever been dismantled or decommissioned, and there are no government regulations to deal with cleaning up a reactor site. She says many utilities are not prepared to handle the coming costs.

> *Many utilities have not set aside adequate funds to pay for the decommissioning, so future customers or taxpayers will be charged for decommissioning the plants from which they derived no power, no benefits.*

Pollock says if and when a way is found to safely dispose of retired reactors, doing so could cost hundreds of millions of dollars for each one.

■ ***January 1987***

■ From Here to Eternity

The federal government has ambitious plans to dispose of high-level radioactive waste. But will they work?

Since nuclear energy was harnessed four decades ago, a nagging problem has plagued the nuclear power industry and the government: what to do with the waste, which can remain dangerously radioactive for thousands of years. Millions of pounds of spent nuclear fuel rods and leftovers from weapons production have piled up at nuclear power plants and government facilities. And the piles grow bigger every day.

Congress and President Reagan ordered the federal Department of Energy in 1982 to get rid of that waste once and for all. The Energy Department is under orders to build underground repositories where it can bury the waste permanently. The first repository is to begin operating in Texas, Nevada or the state of Washington by 1998.

Under the federal plan, the waste will be packed in triple-insulated containers, lowered as deep as 4,000 feet into granite tunnels and sealed into the floors. Eventually, the shafts will be refilled with crushed rock.

At ground level, 16 square miles will be fenced off and heavily guarded. Trucks carrying crash-proof casks of nuclear waste will arrive almost hourly for 30 years until 70,000 tons of waste have been buried. The facility will cost an estimated $50 billion and employ 1,500 people.

Despite such detailed plans, federal officials are quick to admit they've never done anything like this before. In fact, no one has. And the lack of a proven track record in high-level nuclear waste disposal has compounded public criticism of the plans. ■ ***April 1986***

■ Dirty Diving

Thirty-five brave men and women swim through lethal waters to see that justice is done.

This is not a job for the faint-hearted or the squeamish.

Divers employed by the U.S. Environmental Protection Agency descend into the deep in search of hazardous waste. They're the agency's underwater watchdogs, and they're out to make sure would-be water polluters stay in line.

Decked out in orange, double-lined body suits, the EPA divers often swim in contaminated waters to gather evidence against illegal dumpers. Using the buddy system, they dive as deep as 130 feet into what may be deadly chemicals. In their underwater quests they've encountered everything from drums of hazardous waste and loads of sewage sludge to illegally dumped fish remains.

EPA divers have investigated the bottom of highly polluted Boston Harbor. They also have worked in Long Island Sound, in water so murky they had to feel their way around. And they recently discovered deadly hydrocarbons in Seattle's Lake Union. As a result, the lake is now off-limits for fishing and swimming.

Dwayne Karna heads the EPA's West Coast diving team. He says sometimes its work is more comical than dangerous. During a diving excursion off Kodiak, Alaska, for example, Karna's team got a surprise. As divers snapped pictures of fish waste illegally dumped by a seafood processor, a group of thousand-pound sea lions swam up. The playful animals slapped the divers around. The EPA employees scrambled back into their boat. The sea lions barked at them to come back into the water.

But lighthearted moments are rare for the EPA divers. Karna admits that the job makes him a little nervous. It's a dirty business, he says, but someone's got to do it. ■ ***November 1988***

■ Fish and Chips

Here are some fish and chips you won't find in a restaurant.

A compost made of fish remains and wood chips may help fishermen get rid of the mess that's left after they clean their catch.

This problem is very real in fishing country like Wisconsin's Door County peninsula, which separates Green Bay from Lake Michigan. The region has thin soil, so fish wastes must be trucked up to 70 miles to a landfill near the city of Green Bay. The cost of this disposal is steadily increasing.

Lynn Frederick, a University of Wisconsin Sea Grant field agent, suggested to two UW-Madison scientists that they use fish remains as a compost. Soil microbiologist Robin Harris is now testing wood chips as an essential ingredient of the compost mixture.

> *We take about an equal weight of dry wood chips and wet fish wastes, which is heads and backbones and tails and guts and whatever. And if we mix that 1-to-1 ratio together, then the liquid part of the fish gets readily absorbed into the wood chips, and it's a fairly dry mixture.*

Harris says this initial product can be ground and mixed with more wood chips to help it decompose. The final product should be a well-aerated compost free of odors and flies and easily handled.

UW-Madison horticulturist Lloyd Peterson will eventually test the product as a fertilizer.

> *I really can't foresee any problems once we get to plant testing. And as a soil amendment, I think it's going to be excellent. I think it's just a matter of getting it in the right condition.*

Peterson and the other Sea Grant researchers point out that a fish-and-wood-chips compost makes good environmental sense. They hope the technology can be simplified enough to offer an economic alternative to landfill disposal.

■ ***October 1985***

■ New Life for Old Milk Jugs

Plastic. It has the ring of something cheap and artificial. Even worse, its various forms represent potential waste and litter. But now some plastic milk bottles are being recycled as a valuable and durable resource.

For three years, a Luxemburg, Wisconsin, plastics manufacturer has collected used milk jugs and turned their polyethylene into a tough, wood-like material. One of the company's first customers was Port-A-Pier, a family-owned firm in Manitowoc, Wisconsin, that builds boat docks and piers.

When western cedar wood became too expensive, owner Bill Paulson cast about for a substitute planking for his piers and docks. He heard about the recycled milk bottle operation and soon became a satisfied customer. From the plastic sheets, he cuts out inch-thick planks. As the planks weather, they take on the appearance of wood. But unlike wood, they do not crack, chip, or peel. And they grip nails and screws tenaciously.

Last July one of those big storms that come about every 10 years pounded the Green Bay shores of Door County. Paulson says five or six of his piers were among those battered.

> *And our piers were the only piers that stayed in the water, using this plastic decking. We feel that what helped our products at the end was that the plastic decking has a little give to it, whereas wood has no give at all.*

Recycled milk bottles are also ending up in lawn furniture, park benches, livestock pens and golf-course bridges. In these and other products, the tough plastic resists breakage, vandalism, chewing animals and spiked golf shoes—and the homely milk jug takes on new life. ■ ***January 1984***

■ Solar One-Holer

Perched on a ridge in the wilds of Maine, just a few feet from the Appalachian Trail, is an $8,000 outhouse.

The price may be a bit steep, but this is no ordinary outhouse. It is specially designed to treat human wastes using the sun's heat. It requires no chemicals. It is odorless and nonpolluting. It is simple to clean and maintain. And it produces a sanitary byproduct that is easy to handle.

Proponents have nicknamed it the "solar one-holer," and they say it could solve a problem as old as camping itself. The outhouse serves a popular mountain campsite that accommodates about 20 people a night. The soil in the area is shallow. The temperature is generally cool, and the air is thin because of the altitude. All of this inhibits the decomposition of organic wastes. An old-fashioned outhouse here must be moved to a new spot about once a year. That's a tedious job, and woe to the camper who happens upon one of its former locations.

The solar one-holer, on the other hand, never needs to be moved. Its solar panels and construction absorb and circulate heat through a composting tank below that turns organic waste into dry humus. The humus can be spread over the ground with no ill effects on the campers. In fact, it actually enriches the soil.

Its proponents admit that $8,000 is a lot to shell out for an outhouse. But they say that if the design proves reliable over time, solar one-holers—or four or five-holers, for that matter—could be mass-produced at much lower cost. And if it works on a mountain in Maine, it ought to work elsewhere.

That could be good news not only for campers but for lakeside-cottage owners, park operators and others whose conventional outhouses don't work as well as they ought to. ■ ***November 1982***

■ A Saline Solution

It damages roads, bridges and automobiles. It contaminates water supplies. And it can poison plants and animals and endanger human health. Yet each winter we pour tons of it on our streets and highways. Sodium chloride, the salt used to de-ice roads, is widely considered indispensable to safe winter travel, despite the problems it creates.

When salt dissolves, the sodium and chlorine go their separate ways. The sodium often ends up in wells and aquifers, posing a threat to people with hypertension or heart disease. And chlorine, one of nature's most corrosive elements, eats holes in highway structures and car bodies. Stanley Dunn of Sedun Incorporated, a private research firm in Madison, Wisconsin, has developed an alternative to road salt. It's an organic compound called calcium-magnesium acetate, or CMA, and Dunn claims it's noncorrosive, nonpolluting and effective at even lower temperatures than salt. With all those advantages, why aren't snow-belt communities spreading CMA on their icy streets? The primary reason, says Dunn, is economics.

> *The very cheapness of sodium chloride: It's found in deposits all over the country in very pure form. All you have to do is mine it, grind it and sell it, and it's very cheap. You can't beat that for a cost of something—you're talking a penny a pound.*

Unlike sodium chloride, CMA is expensive to produce. But Dunn believes that using CMA would actually be cheaper in the long run if salt-related damages, estimated by the U.S. Environmental Protection Agency at $3 billion a year, were taken into account.

Not everyone is convinced, but the federal Department of Transportation does plan to road-test Dunn's product in three northern states this winter. ■ ***November 1984***

■ Garbage In, Compost Out

Today's trash may be tomorrow's fertilizer. A University of Wisconsin-Stevens Point scientist says landfills are full of valuable resources.

Where will all the garbage go? Many communities are asking that question these days as landfills overflow and new dump sites grow more expensive and elusive. But soil scientist Aga Razvi of UW-Stevens Point may have an answer.

Razvi is working with the Wisconsin Department of Natural Resources on a one-of-a-kind project to turn nonrecyclable refuse into valuable compost. In a low-cost, one-person operation in Lodi, Wisconsin, curbside trash is shredded, mixed with sewage sludge and piled into mounds. Pipes in the mounds allow air to circulate, and a bulldozer occasionally turns the refuse over. As the paper, sewage, cloth and other discarded items decompose, they create enough heat to kill unwanted bacteria. The final product is screened to remove glass and metal, leaving a fine soil-builder that farmers can spread on their fields.

Razvi says the process saves three-quarters of the landfill space the trash would have occupied. And he says the compost increases the ability of farm soil to retain nutrients and water and makes the soil less vulnerable to erosion. Razvi says his low-tech method of waste disposal is designed for communities of 7,000 to 10,000 people. He points out that it might not work in places with industrial wastes in their sewage. But Razvi says the start-up costs are less than $100,000, and other cities are watching the Lodi project closely.

Composting trash may not eliminate the need for new landfills. But Razvi believes it's a creative and inexpensive way to greatly reduce the need for them. ■ ***June 1985***

A Healthy Profit

Many attempts to protect the environment focus on cleaning up pollutants after they are produced. The 3M Company of St. Paul, Minnesota, is trying to stop pollution before it happens, and it's paying off.

Ten years ago, 3M began a program called Pollution Prevention Pays, or 3P. The company encouraged its scientists and engineers to find manufacturing technologies that pollute less and save money. The 3P coordinator, Sara Zoss, says this made the company reassess its production methods.

> *In the past, the manufacturing process used to be left on its own and then they'd turn to the environmental people and say, 'Well, here's my exhaust or emission, please take care of it.' Now what we're doing is turning the problem-creators into the problem-solvers. And sometimes those are the people that have the very best ideas to begin with.*

The 3P Program has grown from 10 projects in its first year to about 1,200 now. Zoss says every project has to meet three criteria: It must reduce a primary pollutant—one created during manufacturing; it must involve some form of technical innovation; and it must be economical. According to Zoss, the program has saved 3M more than $190 million so far.

It's had other benefits too. Zoss says polluting materials have often been removed from products entirely, reducing disposal problems for consumers and easing the burden on government regulators.

3M's pollution-prevention approach could catch on elsewhere. Zoss says the company gets hundreds of inquiries every year from other firms curious about how it works. ■ ***November 1984***

Paper Revolution

A new way to pulp wood may save trees and money and virtually eliminate paper-mill pollution.

The century-old technology used to break down wood to make paper has been a heavy polluter of air and water. But a University of Wisconsin-Madison wood chemist says that may soon end.

Forestry professor Raymond Young has discovered a way to process pulp wood that he says will revolutionize the paper industry. The new method, called ester pulping, uses no sulfur—the main pollutant from paper mills. In fact, says Young, ester pulping emits no pollutants at all: Every chemical used is recycled, and one of them, acetic acid, is extracted from the wood itself.

Young says the process may save the paper industry millions of dollars. He says new ester mills will cost half as much to build as conventional mills, use less energy and get more pulp from the wood.

> *We've found that yields are dramatically increased, almost doubled, compared to current pulping processes. So the increased yield is an incentive because even a small increase is worth millions of dollars.*

Young says ester pulping could boost paper-mill production 50 percent without consuming more wood. That, he says, could save a lot of trees.

Paper companies are intrigued by Young's discovery. They are eager to avoid spending money on pollution-control equipment when many of them are not doing well financially. And Young says the companies that are worst off could benefit most from ester pulping.

> *That's in our plans, to basically retrofit those old mills and jump in with a new process, and maybe we can revitalize total communities that normally would go down the drain. It could have a great economic impact.*

■ ***December 1985***

De-oil in the Water

New chemicals make breaking up easier to do.

Some of the most dramatic images of marine pollution have come from oil spills—beaches blackened by sticky lumps of crude oil, and birds and other wildlife befouled and dying. But dispersants offer hope in the war against oil spills. Dispersants are chemicals that break up oil, causing it to disperse in the water, where it evaporates or breaks down. Oil treated with these chemicals poses much less of a threat to the marine environment than oil that remains in a slick.

Gordon Lindblom is a research scientist with Exxon Chemicals Technology in Houston, the world's leader in dispersant technology. Lindblom says dispersant chemicals could drastically change the efficiency of oil-spill cleanups.

> *If there is oil on the sea—that is, if there has been a spill—you have only two choices: Let it come ashore and handle it there—everyone knows the problems that entails, to say nothing of lawsuits and things that follow a massive cleanup—or handle it at sea and prevent it from coming ashore. That's the main thing about dispersants: They are preventive of environmental damage.*

Exxon's Lindblom says dispersant technology has been around for almost 20 years. But early dispersant chemicals were as toxic as oil, and they created as many problems as they solved. However, scientists have made great advances in dispersant safety in the last 15 years, and today's chemicals are not toxic to marine life. Lindblom thinks further research will perfect techniques for using dispersants and will ultimately save beaches and wildlife imperiled by spills at sea. ■ ***June 1986***

Nose to the Grindstone

The people of Jacksonville, Florida's odor patrol follow their noses to the job.

At first glance, Jacksonville, Florida, with its pleasant climate, fresh sea breezes, and white beaches, seems to have a lot to offer. But for years the city has been known more for its bad smell than for its attractions.

The odor comes from pulp mills and chemical plants in the area. The smell has driven property values down. The situation had become so bad in recent years that many people reported feeling sick from the stench.

Jacksonville city offices have been bombarded with odor complaints. In 1987, a new mayor set out to clear the air. Jacksonville passed an odor nuisance law last spring, the first of its kind. The law created a way to regulate air pollution based on odor levels.

Citizens call in complaints on an odor hot line. A group called the odor patrol goes into action. Armed with a variety of equipment—and its noses—the team measures wind speed and direction, humidity, and other atmospheric conditions to find the source of the odor. If the patrol is able to verify a complaint, it sends a citation to the offender. The guilty party either draws up plans for changes or faces fines of up to $10,000.

Robert Tolen heads the odor patrol. He says Jacksonville citizens are excited about the city's get-tough policy. They feel it's a chance to make the city more livable. According to Tolen, industries in the area are already making noticeable changes. Back in the spring, the patrol was swamped with as many as 300 odor complaints a day. Now the calls number about 250 a month.

Tolen says he notices fewer odors now on his investigations. He hopes the odor patrol will snuff out Jacksonville's stinky reputation once and for all. ■ ***October 1988***

■ Victims of Pollution

Japan is only the size of California, but its population is half that of the entire United States. This crowded nation exports tremendous volumes of manufactured goods, and its intense industrial activity has produced air and water pollution that is difficult to escape.

As a consequence, Japan passed a unique law in 1973 to compensate people afflicted with diseases caused by pollution. Under the law, a person who contracts a pollution-related disease while living in a highly polluted area may be medically certified as a "victim." The government compensates the victim for medical bills and disabilities. Today, there are 100,000 of these officially certified victims in Japan.

The compensation money comes from a pollution tax levied on automobile owners and industries. The more one pollutes, the more one pays.

Koichiro Fujikura, a law professor at the University of Tokyo, says the victim-compensation system has helped reduce pollution in Japan.

> *It added an extra incentive for industrial concerns to reduce the amount of emissions into the air and to be more careful about the discharge of chemical substances into the water. In that sense, it is very effective.*

Fujikura says the victims form a strong constituency for pollution control. Their numbers help the government determine appropriate pollution standards, and they pose a constant reminder to the nation that more still needs to be done to clean its air and its water. ■ ***May 1983***

■ Recycling Simplified

A California city makes recycling as easy as taking out the trash.

With trash collection costs on the rise and landfills nearly full, San Jose, California, like many other cities, faces a waste-disposal crisis. The city has begun a pilot recycling program to cut the flow of trash to landfills. People are asked simply to place their newspapers, bottles, and cans in separate boxes at curbside on trash day. The city provides the boxes. A private waste-disposal company, hired by the city, picks up the junk and has it recycled.

San Jose's recycling coordinator, Richard Gertmann, says the program is popular in neighborhoods where it's being tested. Nine thousand households received free recycling boxes at the outset, and 70 percent are using them.

Gertmann says the pilot program, which so far serves only 10 percent of San Jose's three-quarters of a million people, is less than a year old. But it already has cut the amount of waste the city ships to landfills by 3 percent.

> *We're shooting for a 25 percent reduction in total material for landfill by 1990. That will include a lot of programs in addition to the curbside program. We intend to do yard-waste composting and have the waste-reduction centers do some commercial-industrial recycling in addition to the curbside program. So we have a wide variety of program initiatives to reduce the amount of garbage to landfill.*

Gertmann says it's too soon to know how much money San Jose will save in the long run. But he says recycling costs the city far less than waste disposal. And the city expects an $80,000 rebate next year from trash collectors as recycling reduces the amount of waste dumped into precious landfill space. ■ ***February 1986***

■ Burden or Blessing?

Do environmental regulations hinder economic growth? Some people in industry and government claim they do. They say, for instance, that strict air pollution laws hurt auto manufacturers and tough toxic-waste disposal rules burden the chemical industry. That's one reason why the Reagan administration favors relaxing environmental regulations—to help business grow.

But other people say there is little evidence that such regulations weigh heavily on the economy. On the contrary, they say, environmental laws have helped create a whole new industry—and with it, new jobs—dedicated to pollution control. The few industrial plants that have closed for violating environmental rules, they say, were obsolete and likely to close soon anyway.

Daniel Bromley is a University of Wisconsin-Madison economist. He says environmental regulation can create new costs for some industries, but there may be hidden benefits.

> *It might raise their costs, and usually it does. But it could also lower their costs. If all of a sudden they say, 'Yeah, this old boiler is about to die and we were going to replace it within five years but the government is cracking down on us—I guess we better replace it this year,' has it raised their costs? I don't know. It's pushed an investment into the present, whereas they had planned to put it off into the future. But the nice thing about new machinery is that it's usually cheaper to operate than old machinery.*

Bromley believes what really hurts business is inconsistent regulation from one administration to the next. He says on-again, off-again policies make it hard for industries to plan and encourage them to hold off until the political climate changes to suit them. ■ ***February 1983***

■ Towards Greater Safety

For all that we hear about health hazards in the work place, have we really done much about them? An expert in risk management says we have.

Hazardous waste. Toxic chemicals. Radiation. Most of us keep our distance from these things. But many industrial workers cannot. Their jobs expose them daily to materials and processes that can be deadly.

Congress created the Occupational Safety and Health Administration—OSHA—in the early 1970s to ensure that employers minimize hazards in the work place. Although OSHA took a tough regulatory stance throughout the 1970s, critics complain that it has become too lenient under the Reagan administration. Nevertheless, William Lowrance, an expert in risk assessment and management at New York's Rockefeller University, says most workers are better protected now than they were in the past.

> *I think over the last 10 to 20 years we have accomplished a tremendous amount in making the work place safer in general in this country. We've tackled some enormous problems, such as asbestos, and that's going to go on for a long time. But we recognized it as a problem, we figured out ways to get rid of it and deal with it, and we also helped people who are affected by asbestosis. In fact, OSHA has just adopted new regulations on asbestos covering more than a million American workers who are regularly exposed to the cancer-causing substance. And for the first time, they include construction workers. All must now be specially trained to work with asbestos, and they must wear protective masks in certain areas.*

Not everyone is happy with the regulations. Some industry spokesmen say they're unnecessary; some labor officials say they don't go far enough. But OSHA claims they will cut the risk of asbestos-related death and disease among workers by 90 percent. ■ ***July 1986***

Agreeable States

The governors of the Great Lakes states agree not to let competition for new industries weaken their environmental protection.

Thanks to efforts by the states and provinces surrounding them, the once heavily polluted Great Lakes are recovering. Levels of many toxic chemicals are declining and the lakes' fisheries have come back. Today the fisheries are worth more than $1 billion a year to the region, and Lake Erie, considered hopelessly polluted 20 years ago, is once again swimmable.

But low levels of toxic pollutants in the lakes still raise concerns about public health. And because the sources of the pollutants are many and widespread, the surrounding states can't combat them on their own.

The governors of the Great Lakes states recently agreed to tackle the problem together. Lyman Wible of Wisconsin's Department of Natural Resources says the governors agreed that protecting the lakes requires extraordinary cooperation.

> *These political boundaries that we all recognize and have to deal with, they ought not be boundaries on the resolution of these problems, and we're giving them higher priority. We want state employees, we want advisors on environmental issues, to go out and talk to each other, spend the time, make it a priority, get moving on this stuff.*

State officials will do more than just talk. The formal agreement calls for 34 specific actions to combat toxic pollution over the next few years. They include guidelines for dealing with chemical spills and consistent consumption advisories on toxic levels in sport-caught fish.

But the governors also agreed not to let competition between the states to attract industries interfere with antipollution efforts. They agreed to keep tough environmental regulations on the books and to enforce them fully, even in the face of pressure for new economic development.

■ ***July 1986***

Return of the Returnables

The returnable bottle is becoming fashionable again. In the last decade or so, nine states, including Iowa and Michigan, have adopted laws requiring deposits on all beer and soft drink bottles and cans.

Oregon passed the nation's first so-called bottle bill 11 years ago, and state officials there say it has been a big success. William Bree of the Oregon Department of Environmental Quality says more than 90 percent of the deposit containers sold in the state are brought back for redemption. Studies by his department show that litter has been reduced 83 percent and substantial amounts of energy have been saved annually. The law also has created jobs and reduced some beverage prices.

Bree believes putting a price on bottles and cans helped change people's attitudes in Oregon. He says it promoted a recycling spirit that has been the real key to the deposit law's success.

> *The system works because of the actions of the public. All the success is a result of the people, the public actions and the public attitude and the public acceptance. All the law does is provide the structure under which it can take place.*

Deposit laws still have many critics, though, and voters in four states—Arizona, Colorado, California, and Washington—recently rejected bottle bills. Opponents claim recycling is possible without regulation, and they warn that forced deposits will put people out of work and raise beverage prices.

But supporters of deposit legislation are persistent. And they hope that if more states adopt deposit laws, there will one day be strong support for a national bottle bill. ■ ***December 1982***

Recycling at a Ripe Age

A Wisconsin woman proves people and rubbish need not be retired before their time.

Mildred Zantow was mad when a landfill near her Wisconsin home leaked and polluted her well. She decided it was time to stop simply dumping trash and started her own recycling company. Zantow, who was nearing retirement, won few believers at first.

> *They all thought that was really funny, that Millie is 20 years ahead of her time, people aren't going to do any of this. And I guess that really made me more determined than ever. Men in particular said that I wouldn't have the strength to go through with it, but they changed. They know I'm going to stay.*

Zantow found a buyer for ground-up plastic and cashed in her life insurance policy to buy a grinder. She also recycled aluminum, glass, newsprint, cardboard and motor oil. Business boomed and now, ten years later, it's still thriving. Last year the company recycled 1,000 tons of refuse, saving space at the county landfill and $19,000 in dumping fees. And Zantow says her company jobs took three families off welfare. All of that changed local attitudes about recycling.

> *When I started they said, 'Ugh! You mean clean out a cat food can? I'll never do that!' And now they not only clean them out, they de-label them, they wash them, they flatten them, and they bring them to me. That is just one symbol of what is happening.*

Millie Zantow says it's worth spending her golden years in garbage for clean water and longer-lived landfills. ■ ***April 1988***

Lost in Space

Since the launch of Sputnik I—the first artificial object in space—in 1957, the Soviet Union, United States and other nations have hurled over 3,000 payloads into orbit. As a result, thousands of pieces of space junk, ranging from microscopic particles to dead satellites that weigh several tons, now clutter space as they rush around the Earth at seven miles per second.

Keeping track of this space debris is the job of the U.S. Air Force Space Defense Operations Center in Colorado Springs. Using super-sensitive equipment, the center can track any object larger than four inches. It takes 30,000 observations daily and meticulously tracks and catalogs the orbits of 5,000 artificial objects.

Only about 250 of the objects in space are operational, including more than 40 nuclear-powered devices, which carry an estimated ton of enriched uranium and plutonium-238. The rest is junk—spent satellites and rocket stages, separation devices, and even an American astronaut's lost Hasselblad camera.

Most of the debris is the result of more than 60 explosions in space. An American Nimbus weather satellite that blew up in 1970 dumped 318 trackable pieces of junk and myriad smaller fragments into orbit. The Soviet Union routinely blows up exhausted satellites, and some authorities estimate the smaller, unseen fragments in space could number in the tens of millions.

While there has never been a collision involving a manned spacecraft, it is believed collisions with space junk have caused some unexplained satellite failures. And with space debris increasing at the rate of more than 10 percent each year, some space authorities fear the probability of such a collision will eventually reach unacceptable levels, perhaps within a decade. ■ ***October 1983***

■ New Deposit, Big Return

Aluminum manufacturers have discovered a rich "deposit" of aluminum that, until recently, was almost untapped. They have found the valuable metal along highways, in parks and towns, even in the middle of major cities. And nobody minds them taking it. In fact, millions of citizens are helping them.

That's because the "deposit" is ordinary trash, and it's full of aluminum that used to be discarded. Nowadays, aluminum companies pay good money to those who save aluminum and return it to them via recycling centers.

The biggest source of the metal in trash is soft-drink and beer cans. Before 1972, only 15 percent of these cans were recycled. Now it's more than half.

Why the big change? Quite simply, the aluminum industry finds it cheaper to make products from recycled aluminum than from aluminum ore. Almost all of the ore comes from overseas, and it takes a lot of energy to mine and refine. Energy costs account for a fifth of the price of aluminum products made from scratch. They are substantially less for products made from recycled aluminum.

Beverage cans made up more than half of the two million tons of aluminum recycled in 1982. Aluminum companies now have their eyes on automobiles as another cheap source of the metal. Most junked cars today contain about 75 pounds of aluminum. When 1983 cars hit the scrap pile in a few years, they will yield about 135 pounds each. And one 1984 model contains more than 400 pounds.

Aluminum companies clearly want to step up recycling. They are studying more efficient ways to separate aluminum from less valuable metals and to identify and sort different kinds of aluminum. They also are campaigning for less expensive freight rates for scrap metal, something that would make aluminum recycling even more economical than it is today. ■ ***April 1984***

■ Dumping Diapers

Disposable diapers rank at the bottom of a Michigan group's list of environmentally sound consumer products.

The Ecology Center of Ann Arbor, Michigan, has named the disposable diaper the Most Wasteful Consumer Product of 1986. The environmental group says throwaway diapers waste energy and paper, and they also gobble up valuable space in overburdened landfills.

Center spokesman Bryan Weinert says the average baby uses at least eight diapers a day through age two. He says with six million children in the United States less than two years old, and with more parents rearing their children on disposables, billions of the diapers end up in landfills each year.

Weinert says most landfills are not designed to handle what's in those diapers. As a result, he says, bacteria leaking from the dumped diapers could reach groundwater and spread disease.

> *We've got very sophisticated systems throughout the country for the processing of human waste, and yet we kind of slapped that in the face with disposable diapers and said it's perfectly legitimate to take human waste and throw it in a landfill.*

Weinert notes that most adults would not consider buying disposable clothes for themselves.

> *It's obviously more efficient to have clothes that you can wear over and over again, that you just need to wash and then can wear over and over again, rather than having either cloth clothes or paper clothes or plastic clothes that you wear once and throw away.*

According to the Ecology Center's Weinert, one reusable cloth diaper is worth hundreds of disposables. He says parents who are too busy or cannot stand to wash cloth diapers should look into diaper delivery services. He says most of the time even those services cost less than using disposables, and for many people, that's the bottom line.

■ ***September 1986***

■ Shifting Gears

If you're overwhelmed by all the junk you carry to the curb on trash day, imagine how the people at Buick City feel. Buick City is a General Motors assembly plant in Flint, Michigan. Seventy-five percent of all the parts and supplies that go into the Buicks and Oldsmobiles made there come in throwaway containers. Every year, the plant has to get rid of 87,000 square feet of corrugated fiberboard, 1,600 wooden pallets and tons of other packaging materials.

Buick City's dilemma is typical of the car industry, but its response is not. Beginning next September, General Motors will require that all parts and supplies used at the plant come in returnable, reusable containers. The policy is part of a complete overhaul of the plant's operation aimed at cutting waste of all kinds.

General Motors hopes to save $6 million a year at Buick City from not having to store and dispose of throwaway containers. David Johnson, a waste-management specialist at Michigan State University, says industry is watching the experiment with great interest.

> *If Buick City makes this thing go and they decrease costs as much as they claim, about $10 per automobile, the whole manufacturing system—I'm talking about major manufacturers, not only automobiles but tractors, you know, and anything that is assembly-line oriented—could very, very quickly follow in that same pattern because it's time-saving, it's space-saving, it's cost-saving.*

And there's a kicker to the story. Johnson says most of the reusable containers designed for Buick City will be made of recycled plastic. If other manufacturers follow suit, he says, it could open up a whole new market for plastic recycling.

■ ***March 1985***

■ A Plague of Plastic

A recent government report says plastic litter plagues the Great Lakes.

Plastic debris has become a nuisance in both the Atlantic and Pacific oceans. The debris entangles marine wildlife, threatens coastal recreation and inconveniences fishermen. A report by the U.S. Environmental Protection Agency indicates that plastic debris is plaguing the Great Lakes as well.

Marine biologist Kathy O'Hara of the Center for Environmental Education wrote the EPA report. O'Hara surveyed national wildlife refuges and natural resource departments in the states surrounding the Great Lakes. She says all states bordering the Great Lakes report that plastic waste has become a nuisance to fish and wildlife. And she says all kinds of plastics are causing problems.

For example, a Michigan State University biologist estimates one out of every hundred birds on the Great Lakes gets entangled in fishing line or six-pack rings every year. On Lake Superior, trawlers report that a lost plastic fishing net a half-mile long had trapped about a hundred pounds of fish before it was salvaged. Plastic nets are slow to decompose, and they can continue to trap and kill fish after they're lost. The state of Michigan has banned plastic nets for this reason. O'Hara says U.S. and Canadian officials report that plastic tampon applicators are becoming a nuisance on Lake Ontario. They float on the water and accumulate on the shore. And O'Hara says Pennsylvania officials are struggling to clean up polystyrene fast-food containers that litter Lake Erie.

O'Hara points out that the greatest environmental insult of plastic litter is its durability. A plastic six-pack ring, for example, may have a life span of 450 years. ■ ***April 1987***

■ City Limits

In Holland, farms are farms and cities are cities. The Dutch intend to keep it that way.

Across the United States, shopping malls and subdivisions are springing up on what was, until recently, farmland. Few communities seem able to stop urban sprawl. City governments are reluctant to stall economic development, and farmers near urban areas can make more money selling their land than farming it.

Some European countries have proven that urban sprawl is not inevitable. Herman Felstehausen, a professor of landscape architecture and environmental studies at the University of Wisconsin-Madison, says the Netherlands is an example. It's the most densely populated country in the developed world. Land is scarce, yet agriculture thrives.

Felstehausen says tough laws keep farmland affordable to farmers but out of the hands of speculators.

> *They simply set up requirements: If you are going to buy a piece of farmland, then you must be a farmer.*

When Dutch cities need to expand, voters decide where and how much. Felstehausen says city governments then play middleman.

> *The city government will actually go out to the fringe of the city and acquire the land at public expense. And it will then draw the basic floor plan, the blueprint for that area, deciding where the streets will be, what the services will be, and how big the lots will be.*

The city then sells the land at a profit to developers, who take it from there. The profits pay for utilities, police and fire protection, and other urban services. Felstehausen says this combination of careful planning and free enterprise keeps Dutch cities orderly and attractive and saves farmland. ■ ***October 1988***

■ Ski Control

Ski resorts in Colorado and Vermont are booming. But critics say the environment around them is sliding downhill.

The populations of two Colorado resort areas—Vail and Aspen—grew nearly 400 percent in the 1970s. Ski-resort development is robust in Vermont, too. And controversy has developed in both states.

In Colorado, the National Forest Service is permitting new resorts to be built on federal land near Vail despite the opposition of state wildlife officials. John Seidel, Vail-area supervisor for the Colorado Division of Wildlife, says new developments will interfere with the migration of elk, mule deer and other animals.

The Forest Service says it has considered how the resorts will affect wildlife on its land. But Seidel contends that development on private land around the resorts will have greater impact. He says neither the federal nor state government can control that growth once the resorts are built.

> *You have an awful lot of approved subdivisions that have not been built at this point in time. When they are built, I think it's going to really affect the quality of life and the esthetics of the valley. They're very narrow valleys, and they're being completely filled with human habitat.*

Seidel says county governments in Colorado can restrict ski-related development, but counties hesitate to interfere with what is often their major source of employment. Vermont is trying to control growth around its Green Mountain ski resorts by limiting the number of sewage discharge permits for new subdivisions. The resulting controversy has embroiled the state and developers in public debates and law suits.

Critics in both states say long-term plans are needed to control ski-area growth. But John Seidel says in Colorado, at least, the prospects for such plans are dim. ■ ***January 1986***

■ Paying the Piper

In the upper Midwest, the question is how to stimulate economic growth. In some parts of the Sun Belt, the question is how to cope with it. Development holds the promise of new jobs, a broader tax base and prosperity. But it also has its price. Nowhere is that more evident than in Palm Beach County, Florida.

One local newspaper reporter says Palm Beach County used to be a "sleepy bedroom community" compared to nearby Fort Lauderdale and Miami. Not any more. Housing subdivisions, high-rise condominiums, business parks and shopping centers have sprung up all along U.S. Route 1 and Interstate 95. The county now has 100,000 more residents than it did five years ago—many of them retirees. New homes are selling at a rate of 750 a month. Some economists predict the West Palm Beach-Boca Raton metropolitan area will be the fastest growing in the nation in the next three years.

Many people in Palm Beach County are ecstatic. Real estate and other businesses are booming. But others regret the county's transformation. They have watched traffic snarls, crime and pollution multiply. They've seen development eat away at the county's shoreline and forests.

Now they face the most unwelcome prospect of all. Palm Beach County needs additional courthouse space, a new trash incinerator and landfill, and more and bigger roads to handle all the newcomers. Those will cost hundreds of millions of dollars. One county commissioner says the biggest local issue of 1985 will be how to raise the money without, as she puts it, "taxing residents right out of the county."

The Snow Belt may have its economic problems, but if Palm Beach County, Florida, is an indicator, all is not roses in the Sun Belt, either.

■ ***January 1985***

■ Turnaround at Tahoe

Gaze into the waters of Lake Tahoe and you may have to catch your breath. This large mountain lake straddling the California-Nevada border is so clean you can see objects more than a hundred feet down.

But Lake Tahoe's remarkable clarity faces a formidable threat. People have built many new vacation homes, stores, high-rise hotels and even gambling casinos along the shores. No sewage is permitted in the lake. But all the development has stripped the surrounding land of trees and other plants that once kept soil and nutrients from washing into the lake and polluting it.

Alarmed by the problem, representatives of California and Nevada recently agreed on strict environmental standards that will control future development around Lake Tahoe. Charles Goldman, a limnologist at the University of California-Davis, says the pristine quality of the lake would be lost without such standards.

> *If development were to continue in the Lake Tahoe basin at its current rate, we'd be looking at a very ordinary, green lake within our lifetimes. The only way to preserve the quality for future generations is to be firm about the zoning already established, to prevent construction on steep, erodible slopes, and bring the basin under control. If we can't do it here, with the tremendous affluence, with one of the most populous and economically successful states in the union, it can't be done anywhere.*

Goldman says it may be several decades before the benefits of the new environmental standards are noticeable to most people. But eventually they will assure that Lake Tahoe is actually cleaner than it is now. ■ ***September 1982***

From Boom to Bust

The boom has gone bust in Austin, Texas, and the city's still paying the bills.

For developers, real estate agents, and bankers, it was the best of times. Austin, Texas, became a magnet for high-tech industries, and by the early 1980s it was the nation's fastest-growing city. Property values soared and construction boomed.

Austin officials tried to control the rate and location of new growth by refusing to extend public utilities beyond city limits. But Texas law allows developers to put in their own utilities. So private development centers, complete with shopping malls and subdivisions, sprang up outside the city. Austin's metropolitan area doubled between 1980 and 1986.

To regain control of the growth beyond its borders, Austin cut deals with the developers. The private growth centers would abide by city zoning ordinances and building codes. In return, the city would provide water, sewer, and other services. It also would assume some of the developers' debts.

But the boom ended in 1986 after falling oil prices crushed the Texas economy. The bust left Austin with vacant homes and office buildings and a $2 billion debt. Kent Butler, an urban planner at the University of Texas-Austin, says city planners were certain the boom would continue. They thought there would be plenty of new customers to help pay for construction of sewer and water lines to the new developments. They were wrong. And as a result, says Butler, Austin residents are picking up the tab. Their utility bills have risen by as much as 27 percent a year.

Butler says Austin's booming growth was intoxicating, but the city should have foreseen a hangover. He says the experience is a lesson for those who advocate unhindered growth: There are no free lunches. ■ ***November 1988***

Close Quarters

Tailor-made neighborhoods are designed to make home life more efficient and friendly.

Many people have trouble finding housing to [illegible] needs. Conventional houses may be too [illegible] expensive, or too much trouble for the el[illegible]le people and working parents. Apart[illegible] condominiums often do not suit families with children, and others find them too confining and impersonal.

A new form of housing—one that's popular in Denmark and beginning to catch on in the United States—may solve these problems. It's called cohousing, and it consists of 15 to 30 side-by-side dwellings. Groups of people plan, build and live together in these custom-designed neighborhoods.

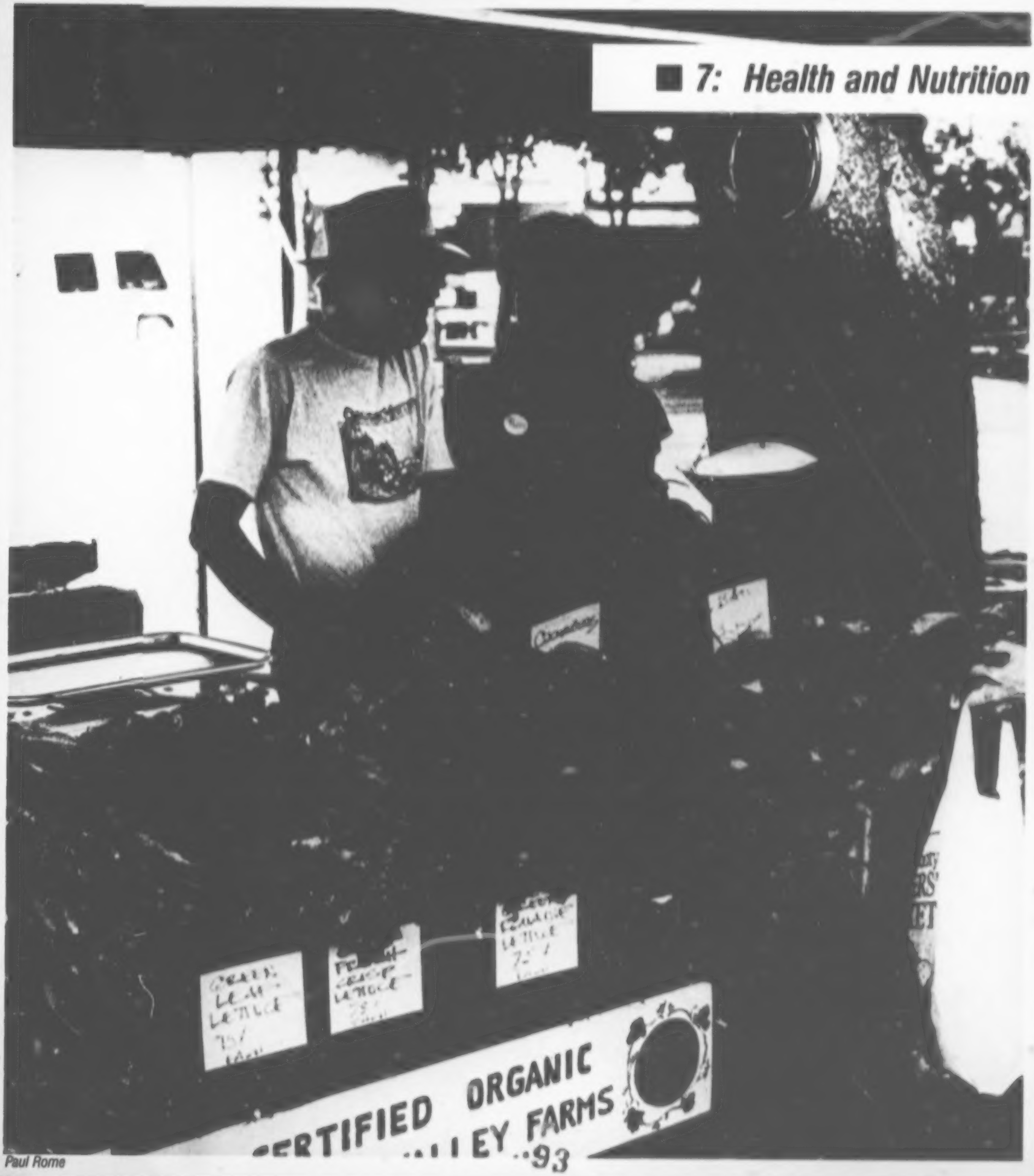
Each unit has a private back yard and a front lawn facing a grassy commons. Laundries, gardens, workshops and playrooms are shared. So is a large dining room, although each unit has its own kitchen. Residents can dine alone or with others. The units have movable walls and can expand or contract to fit changes in family sizes.

Architectural designers Kathryn McCamant and Charles Durrett have written a book about these innovative dwellings entitled, simply, *Cohousing*. McCamant says cohousing gives people a sense of community that they've lost in recent generations to careers, frequent moves, and growing distances between family members. She says the tightly knit neighborhoods also use land and energy efficiently without making people feel crowded.

> *It's much more viable to incorporate various innovative systems—such as solar energy systems, recycling systems—at that scale than it is in a single-family house, so you can do more with appropriate technology.*

McCamant says some 25 groups in the United States, mostly on the West Coast, already are designing their own cohousing neighborhoods.
■ ***September 1989***

■ 7: Health and Nutrition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Paul Rome

Fish Fat Facts

Scientists say fish in the diet helps prevent coronary heart disease. Now it seems eating fish may also prevent certain cancers.

The fat in meat, fish and vegetable oils affects human health in a variety of ways. Red meats, for example, contain saturated fats that, in excess, may impair blood circulation and lead to coronary heart disease.

Nutrition scientist Rashida Karmali of Rutgers University says there is evidence that certain fatty acids in vegetable oils and meat may also lead to cancers of the breast, colon and prostate. These risky compounds, called omega 6 fatty acids, are found in sunflower, corn and safflower oil, ingredients common to the average American diet. As a nutritionist, Karmali is concerned.

> *The fact that we are eating 40 percent of our total calories as fat is too high. And we really should aim at reducing our fat intake down definitely to 30 percent, or even down to 20 percent, of the total calories if that is possible.*

But Karmali also has good news: Fish oils contain a different set of fatty acids called omega 3. In animal studies, Karmali finds that these organic compounds probably counter the harmful effects of the omega 6 fats.

Karmali says we don't have to live by fish alone.

> *What is important is to have an optimal ratio of the different types of fatty acids from fish oil and from vegetable oil.*

As a rule of thumb, the Rutgers nutrition scientist suggests that we eat fish at least once or twice a week while reducing the overall level of fat in our diets. ■ ***June 1986***

Waiter, There's No Fly in My Soup

Dry-roasted grasshoppers, crickets in garlic sauce, or deep-fried caterpillars: In some parts of the world, insects are gourmet items.

Gene Defoliart says he's got a good recipe for a type of caterpillar.

> *They're about an inch long, I guess . . . white, hairless. You drop one of these into a deep-fat fryer, leave it for about 40 seconds, and pull it out and dip it in salt. It melts in your mouth and it tastes just like bacon.*

Defoliart's testimonial may leave your taste buds rather cold. But the University of Wisconsin-Madison entomologist says insects are commonly eaten in many parts of the world.

> *You go to Africa or South America: In many places, in the indigenous populations, if you give them a choice, they prefer insects. You can keep the beef; they'll take the insects.*

Defoliart says people in most non-European cultures eat at least some insects. In rural Japan, grasshoppers and bee larvae are a regular part of the diet. Japanese city dwellers wash their waterbugs down with a stiff drink. And in Thailand, gourmets consider grasshoppers the perfect snack alongside a beer.

But in many countries, insects are more than snacks. Some Brazilians depend heavily on bugs for protein. In Zaire, a central African country, insects make up a good 40 percent of the animal protein eaten by the average person, and with good reason: They are rich in protein, vitamins, minerals and calories.

Defoliart says little research has been done on the potential nutritional uses of insects, but he believes they could easily be mass-produced for food. In fact, he says, even migrating locusts could turn famine to feast in Africa if people simply caught and ate them. ■ ***February 1986***

■ Bad Taste?

A United Nations economist says a growing taste for North American-style diets is partly to blame for malnutrition in the Third World.

Cassio Luiselli believes poor people in developing countries would eat better if they returned to more traditional diets. Influenced by North American eating habits, he says, these people are spending scarce money on meat, so-called junk food and alcohol.

Luiselli led a team of social scientists and nutrition experts in a two-year study of food and nutrition in Mexico commissioned by the Mexican government. They found that the country as a whole was fairly well fed, but significant pockets of poverty and malnutrition existed.

They traced the problem to a shift away from the traditional, low-cost diet of corn tortillas, squash, beans and rice to one of meat and potatoes. The newer diet, says Luiselli, is more expensive. It also includes some junk food, which gives people little real nutrition, so the poor are paying more and getting less.

The United Nations economist says it takes more energy and land to meet people's protein needs with meat than with grains and vegetables. It also diverts farmland away from growing food for people to growing food for livestock, and that reduces the overall food supply available to the hungry and growing population.

The trend is not unique to Mexico. Luiselli says red meat and imported foods and beverages have become status symbols throughout the developing world. While he does not condemn imported tastes, he believes Third World countries should encourage their people to rediscover their traditional diets. Besides improving nutrition in those countries, it would make them more self-sufficient in food. And that, says Luiselli, is the surest way to strengthen their economies.

■ *June 1985*

■ The High Cost of Carryouts

People in the United States waste enough edible food to feed all of Canada. So says an archaeologist who studies modern-day garbage.

It's called the Garbage Project. For 13 years, University of Arizona archaeologist William Rathje and his students have sorted through household trash in Tucson, Milwaukee, and Marin County, California, in neighborhoods representing a cross-section of American consumers. Their purpose: to find out how much food we waste.

And Rathje says we waste a lot.

> *Our results indicate that, at least in the sample neighborhoods, the households are discarding between 10 and 15 percent of the solid food that they buy. At a national level it's been estimated that we're wasting $11.7 billion worth of food a year.*

The Garbage Project has found that a third of the edible food thrown out is prepared but not eaten. The rest is unused whole items like produce and meat that spoil in the refrigerator. People apparently buy these items intending to prepare fresh meals. But after a long day at work, they often lose that ambition and opt for TV dinners or other packaged meals instead.

Even through recent recessions, says Rathje, the amount of food wasted has remained fairly constant.

> *Householders are just totally unaware of it, so even in times of great economic stress, when food is high-priced, people tend to waste a considerable quantity of food.*

The Arizona archaeologist believes the average family could save $250 a year through better meal planning. If people then donated some of those savings to famine relief, says Rathje, they could pump new life into that old line about cleaning your plate because people are starving elsewhere.

■ *April 1986*

■ This Spud's for You

Pity the poor potato. It's homely, it tastes a little bland, and its history is tarnished by the great Irish famine of the 1840s.

But do not *underestimate* the potato. It ranks right behind rice, wheat and corn as one of the world's most important foods. About 300 million tons are harvested annually in 130 countries. People eat far more potatoes than they do fish and meat. And animals eat a lot of potatoes, too.

Potatoes are not empty calories. Richard Sawyer, director of the International Potato Center in Lima, Peru, says the potato is second only to eggs as the most nutritionally balanced food. He says it has higher-quality protein than most crops, and its proportion of protein to carbohydrates is also high. That means it's not potatoes, but the butter, sour cream and cooking oil people eat with them, that are fattening.

Potatoes are good from the farmer's standpoint, too. Sawyer says they yield more volume per acre than any other crop. They can grow at both low and high altitudes. And they mature more quickly than rice, wheat or corn. Some varieties can be harvested in as little as two months after they are planted.

All this has made the potato an up-and-coming crop in many developing countries, where the balance between food supply and demand is precarious. However, the potato is still vulnerable to diseases and pests, especially in the tropics. And in some ways, it is more expensive to plant, store and transport than other crops. But scientists like Richard Sawyer are trying to work through these problems, and if they succeed, the humble potato may at last get the credit it deserves.

■ ***February 1983***

■ Chemistry, Flavors and Fillets

New discoveries of the chemistry underlying fresh and spoiled fish flavors may lead to longer-lasting, better-tasting seafood products.

What makes fish taste fishy? Robert Lindsay can tell you. Lindsay is a food scientist at the University of Wisconsin-Madison, and he has identified the chemicals that give fish its taste—both good and bad. Lindsay says the processes that make fish taste fishy instead of fresh are preventable.

Two factors are responsible for bad-tasting fish: bacteria and the breakdown of fat in the fish's body through oxidation. Lindsay says most people have a very accurate seafood quality tester with them all the time: a nose. If you wonder how fresh it is, he suggests you take a sniff.

> *That's a very fair rule of thumb for anybody. If a fish product has a distinct fishy aroma, it has been oxidized or been subjected to some microbial growth and deterioration.*

Lindsay says understanding the chemistry of fish flavors may help commercial seafood businesses package fish to keep it tasting fresh longer. It also may help nutritionists use fish oil in more food products without making the food taste fishy. And Lindsay says his work suggests that anglers can keep their fish tasting fresh by skinning their catches promptly, keeping slime from the fish skin from rubbing onto the fillets, and icing fish down.

Lindsay's findings come at a time when consumers are eating more fish. Fish oils apparently help reduce fatty deposits in blood vessels that may lead to heart problems, and research indicates that a regular diet of fish can help prevent certain types of cancer. ■ ***September 1987***

Perilous Panic

What do SCUBA divers and firefighters have in common? They both depend on breathing devices for air. But sometimes those life-giving devices can be deadly.

SCUBA divers rely on portable air supplies to keep them alive. In a smoke-filled building, firefighters do, too. But ironically, their air masks or breathing regulators may sometimes be their downfall.

Some SCUBA divers and firefighters—no matter how experienced—occasionally panic with no apparent cause. It can happen in clear, shallow water with no present danger or on a routine inspection of a smoky house. This panic often causes the victims to believe they can't breathe, and they tear off their life-giving supply of air, then drown or succumb to smoke.

Sport psychologist William Morgan at the University of Wisconsin-Madison believes divers and fire fighters may soon be able to take a combined physiological and psychological test that would reveal susceptibility to panic attacks. The UW Sea Grant researcher says preliminary results indicate these tests may be accurate in up to 80 percent of all cases.

> *In our pilot work with beginning SCUBA students at the university, the psychological profiles have discriminated between those who've gone on to experience panic or near-panic behavior during the course of a semester and those who have not. So there is a lot of reason to believe that what I'm suggesting is, in fact, possible.*

Morgan says if he can accurately predict which people are likely to experience panic, they can quit diving or fire fighting or they can learn psychological tricks to help them cope with panic if it happens. These techniques are easily learned, he says, and they may save a person's life. ■ ***July 1986***

Threads with a Great Disposition

Crab shells may not keep patients in stitches, but they may keep stitches in patients.

When physicians sew up a cut, the thread they use is important. Thread made of natural fibers can cause the body to have an allergic reaction. Thread made of synthetic fibers can cause the body to react defensively and attack the stitches. And neither type of thread can be used to stitch, or suture, some parts of the body. A conventional suture in the urinary tract, for example, will dissolve before the wound heals.

But Sea Grant chemist Paul Austin of the University of Delaware recently discovered a suture material that does not dissolve readily in the body and is nonallergenic. The material is called chitin. Chitin forms the outer skeleton of insects and shellfish, and it is made up of long strands of sugar molecules that harden with age to give these organisms structure and protection.

Research at Columbia University showed that chitin had wound-healing properties, but no one knew how the medical industry could use it. In the meantime, the U.S. Environmental Protection Agency had banned ocean dumping of shellfish wastes. Crab shells, a prime source of chitin, were piling up beside crabmeat processing plants along Delaware's coast.

Austin decided to put the crab shells and their healing properties to work. He found a way to dissolve and extract chitin from discarded crab shells and spin it into thread. He says experiments on animals show that chitin sutures are strong, nonallergenic and will not come untied. In addition, the Sea Grant chemist says thread made from chitin can be used anywhere in the body and will not dissolve until after the wound heals. ■ ***April 1987***

■ The Smell of Success

A keen sense of smell was vital to the survival of early humans. Your nose is just as important today.

Trygg Engen says most people don't realize how much their sense of smell tells them. Engen, a psychologist at Brown University in Rhode Island, is an expert on human responses to odors. He says you're probably not aware of all the smells your nose picks up.

> *The sense of smell is something we use all the time but in a more or less unconscious fashion. We're always noting the odor in a room or a building we walk into.*

Engen says people usually don't think about odors unless they're strong ones. Cooking odors may remind you that you're hungry; foul smells may prompt you to cut short a visit. Engen says these same responses probably gave early humans immediate information about what to eat and what to avoid in their environment. This natural warning system still runs strong. If you eat something and become ill, you don't care to eat or even smell that food again.

Engen runs a hospital clinic for people who've lost their sense of smell. Their frustration goes beyond the meals they can't taste or the flowers they can't smell. They also miss the warnings that foul odors give, whether of spoiled food, a natural gas leak or a fire.

The psychologist adds that sensitivity to odors is also a problem for people in tightly insulated buildings.

> *Odor perception is becoming more and more of interest to air-conditioning engineers because when an odor smells bad, it's likely to be contaminated. The fact is, there isn't any much better index of it than that.*

Put simply, things that smell bad are bad, and your body knows it. ■ ***December 1987***

■ Get the Lead Out

Lead poisoning: It's still a serious problem in the United States.

You've probably heard of lead poisoning as a problem that affects poor, inner-city children who eat peeling paint chips. But studies suggest the problem cuts across age and income levels throughout the United States.

Lead exists in soils and rocks everywhere. Although the human body has no use for lead, it normally contains a small amount. But high levels of lead in the body can cause irritability, nervous problems, miscarriages, high blood pressure, kidney failure and even death.

Lead contamination has many sources. Much of it comes from automobile exhaust and from old pipes and solder in household water systems. Lead is still found in some imported paints and in ceramic glazes used on dishes, even though importing such products is illegal.

Irene Mirkin, an epidemiologist with the Wisconsin Department of Health, says the amount of lead discharged into the environment has dropped because of pollution controls, but scientists now believe that even low lead levels cause problems.

> *The lead levels have gone down in this country over the past few years, and that doesn't mean lead poisoning isn't a problem, but it's now more asymptomatic. Children may have lead poisoning, but they won't show any clinical signs of it. It's important to realize that somebody may not manifest any signs but still have lead poisoning, and that's why screening is so important.*

Mirkin says all children should be screened for lead with a simple and inexpensive blood test. If blood-lead levels are high, the source can often be identified and removed. Mirkin says you need to find out early because many problems caused by lead poisoning are not reversible.

■ ***December 1987***

The Wrong Target

Summer weather means gardening, lawn care or field work for many people. A lot of them will use pesticides, but Walt Gojmerac, a University of Wisconsin-Extension entomologist, says these chemical poisons sometimes hit the wrong target. It may be just a simple mistake when they do, but it can have tragic consequences.

Gojmerac recalls an incident in which a Wisconsin brewery worker was accidentally poisoned because he brought a powerful herbicide home from work in a beer bottle.

> *His wife came along, saw this beer bottle on the window shelf, took it upstairs, put it in the refrigerator. Some time later—I don't know the time sequence—he came in, opened up the beer bottle, took a swig out of it. He did not make it to the telephone to call the rescue squad. He was dead.*

Gojmerac says the tragedy could have been avoided if the man had not put the herbicide in a common beverage bottle that did not have a special label.

He says people should follow a few special rules to keep pesticides on target: Read and follow the directions every time you use a pesticide.

Store pesticides in their original containers with the labels intact. Not only can that prevent an accident, but if one happens, doctors or rescue workers will know what they're treating.

Don't eat, drink or even smoke while using pesticides. The chemicals can get on your hands and in your food, and if they are supposed to kill pests, chances are good the chemicals could poison you as well.

Gojmerac says to be aware of animals and plants that might come in contact with pesticides and to avoid using them around children, livestock or pets. And when you are through using pesticides, clean your equipment, your clothing and yourself thoroughly. Remember that even in small amounts, pesticides can kill, and it pays to handle them with caution. ■ ***May 1984***

Underwater Relief

Soft coral from Caribbean waters may promise relief from pain.

In tropical waters, soft coral abounds in vibrant colors of red, white and purple. It lacks the rigid outer coating of hard coral, so it must rely on chemical defenses to protect itself from predators.

Three Sea Grant scientists from California and New York believe the defensive chemicals these animals use may someday help yield new drugs. The scientists recently discovered that one type of rare soft coral found only in the Bahamas and Florida Keys contains a unique class of compounds that relieve inflammation—the pain and swelling of body tissue and joints. Oceanographer William Fenical of the University of California in San Diego says experiments with mice showed these compounds contain anti-inflammatory agents stronger than the most commonly prescribed drugs. He says the compounds also act in unique ways to relieve the pain associated with swelling.

These findings may lead to the development of new drugs for treating inflammatory conditions. Fenical says the compounds are nontoxic, but it will still take time before they can be synthesized and new drugs are developed from them.

> *We don't know the side effects. The side effects may take years to understand—if there are any. At the moment, we see little or nothing to be worried about. But this is very early testing, and it will require at least 10 years of very thorough testing before we'll have any feelings for side effects.*

The Sea Grant researchers hope the compounds can provide new insight into how inflammation occurs and someday provide new sources of relief to those who suffer pain. ■ ***January 1987***

Homemade Air Pollution

You can't hide from air pollution. Studies have shown that toxic chemical levels may be higher inside your home than outside.

People spend an average of 22 hours a day indoors. That's not good, according to an environmental scientist at the Harvard School of Public Health in Boston. Lance Wallace says toxic chemical levels in the air are often higher indoors than out. Wallace says there are probably thousands of sources of air pollution in an average home. They range from cigarette smoking to hot showers, which release chlorine at five times the levels found outdoors. Wallace says other major sources of indoor pollution are consumer products, such as paints and cleansers, and building materials like adhesives and insulation.

Air stays inside the average home for about an hour before fresh air from outdoors replaces it. In that time, pollutants accumulate and become more concentrated. In the case of carcinogens, Wallace says, the higher the concentration, the greater the risk of cancer.

Wallace says indoor air pollution levels are independent of levels outside. Rural homes tested by the U.S. Environmental Protection Agency contained just as much pollution as urban homes in New Jersey. Wallace believes most indoor pollution originates within homes, and he suggests ways to reduce it.

> *There's several things one can do. Obviously, the simplest is to open a window, even in New Jersey. According to our study, that's better for you in the long run. There are times when you can't, and in those cases, the best thing to do is to take the sources out of the house if possible.*

Wallace emphasizes that these are mostly temporary measures. He suggests that the government set safety standards to help ensure a healthy indoor environment. ■ ***November 1985***

Catching Ultraviolet Rays

The popularity of outdoor summer activities and the advent of skimpy bathing suits have led to an increase in skin cancer in the United States.

Over the past 50 years, Americans have increasingly turned to swimming, fishing, boating and just plain sunbathing for summer recreation. Swimwear has gradually gotten skimpier, and a deep tan has come to represent affluence, fashion and health. But dermatologists consider one resulting trend quite unhealthy—the rising rate of skin cancer in the United States.

Derek Cripps, head of the Dermatology Clinic at the University of Wisconsin Hospital in Madison, says overexposure to the sun produces the worst form of skin cancer, malignant melanoma.

> *It seems that we're seeing it in areas of the body that normally used to be protected. If you look at the swimming trunks, swimming costumes—well, at one time, they were maybe to their ankles, and now they're so brief that you can hardly see them, and there is a rising incidence of malignant melanoma.*

Scientists believe melanoma is caused by long-term exposure to the ultraviolet rays in sunlight, which damage the genetic material of skin cells. Melanoma often first appears on the skin as a blemish or an irregularly shaped mole. According to Cripps, people with fair complexions and red, blond or light-brown hair face the greatest risk of sunburn and skin cancer from too much sunlight.

Cripps, who helped develop the protection rating system for sun screen creams and oils for the U.S. Food and Drug Administration, says melanoma can be fatal if not diagnosed early and treated promptly. The best cure, he says, is prevention: Use sunscreen, wear a hat, and—if you burn easily—put on protective clothing. And, he adds, consult a physician if an irregular mole or blemish suddenly appears on your skin.

■ ***July 1985***

Lighten Up

Does winter give you the blahs? Maybe you should lighten up.

Many people get mildly depressed in winter and blame it on cabin fever. But some people get severely depressed. Scientists call the problem seasonal affective disorder, or SAD.

Neuroscientist George Brainard of Jefferson Medical College in Philadelphia describes the symptoms:

> *Decreased libido, decrease in physical energy accompanied by feelings of fatigue, increase in appetite and increase in carbohydrate craving—and that's often followed by weight gain, much as a hibernating bear would go out and eat a lot more before it slept off the winter—and an increase in sleepiness and increase in sleep time.*

Although researchers are not sure what causes winter depression, they're finding out that more light may help some of its victims. Brainard advises SAD people to cheer up because their problem is probably a physical one that many psychiatrists can treat with light therapy.

Psychiatrist Norman Rosenthal of the National Institute of Mental Health in Maryland says light directly affects the brain. Rosenthal treats his SAD patients with bright lights to make up for the short days of winter. He believes people who get mildly depressed in winter might need only more light in their surroundings.

But Brainard cautions depressed people not to treat themselves with bright light that could damage their eyes. He says most people could simply take walks outdoors because even when it's cloudy, daylight is much brighter than most indoor lighting.

Those who don't like to venture outside in winter needn't despair. Brainard says special therapeutic lights may soon be available in stores.

■ ***December 1985***

Smoke Alarm

Tobacco smoking is a hazard to nonsmokers as well as smokers, according to recent studies.

Although cigarette smoking in the United States is on the decline, more and more people are dying each year of lung cancer linked to smoking. And the victims are not all smokers.

The acting director of the U.S. Office of Smoking and Health, Donald Shopland, says passive smokers—those who breathe in smoke from someone else's cigarettes—stand a strong chance of developing lung cancer, too.

> *The majority of studies are actually showing that nonsmokers who are exposed do tend to be at a higher risk for developing and dying of lung cancer.*

The most recently published study from the American Cancer Society indicates that women who are exposed to heavy amounts of tobacco smoke from their husbands' smoking are twice as likely to develop lung cancer as women who are not exposed in this way.

Shopland says studies also have clearly shown young children are more susceptible to respiratory problems if their parents smoke at home.

But there's hope for the nonsmoking majority, at least in public places. Only a third of all adults in the United States now smoke cigarettes—down from 43 percent two decades ago. Shopland says 40 states now have laws that limit smoking in public places, and most smokers accept them.

> *There have been a number of surveys published, not only by people like the American Lung Association but even by the Tobacco Institute, that have shown over and over again that even the majority of smokers accept reasonable restrictions for smoking in public places.*

Shopland says unwanted smoke in the air is no longer considered merely annoying to nonsmokers; it's now recognized as a potential threat to their health. ■ ***February 1986***

Gut Reaction

The crystal-clear mountain stream that beckons thirsty hikers and campers to drink could cause months of intestinal distress.

As many as 16 million Americans are thought to be infected with the parasitic microorganism known as giardia. Giardiasis causes intestinal cramps, bloating and diarrhea that can last for months. The parasite interferes with the body's ability to absorb nutrients, resulting in weight loss and weakness.

Dr. Dennis Maki, an infectious-disease specialist at the University of Wisconsin Hospital and Clinics in Madison, says although giardiasis has been around throughout human history, its infectious cysts have recently shown up in unexpected places.

> *We think of crystal-clear, pure streams in the Rocky Mountains. There's contamination by giardia cysts. And it's recently been found that in other mammals, such as beavers and muskrats, the parasite is able to infect these animals, and they can be a reservoir for infection and contamination of the water supply.*

Maki says more than 60 giardiasis epidemics broke out in the United States in the past decade, mostly because of breakdowns in the purification of municipal water supplies. But he says common-sense measures could prevent many of the individual cases he regularly sees.

> *Anybody who is going camping, particularly in the Rocky Mountains area, and is going to drink the water in the lakes or streams would be well advised to either boil the water or to pretreat it with halazone tablets.*

Halazone is an iodine compound available at most pharmacies.

Maki says people traveling to developing countries should take similar precautions. And he stresses that even in many industrialized countries, such as the Soviet Union, giardia contamination of the drinking water is alarmingly common.

■ ***August 1985***

The Big Chill

Victims of hypothermia require special treatment if they are to survive the big chill.

Recently, a 10-year-old Massachusetts boy was pulled from an icy pond two hours after he fell in. He barely had a pulse, and his temperature was just over 70 degrees Fahrenheit. Unfortunately, the boy didn't make it; he died, a victim of acute hypothermia—low body temperature.

Someone who falls into cold water will begin to suffer from hypothermia within minutes. And though it takes longer, it can also affect persons exposed to the cold on land.

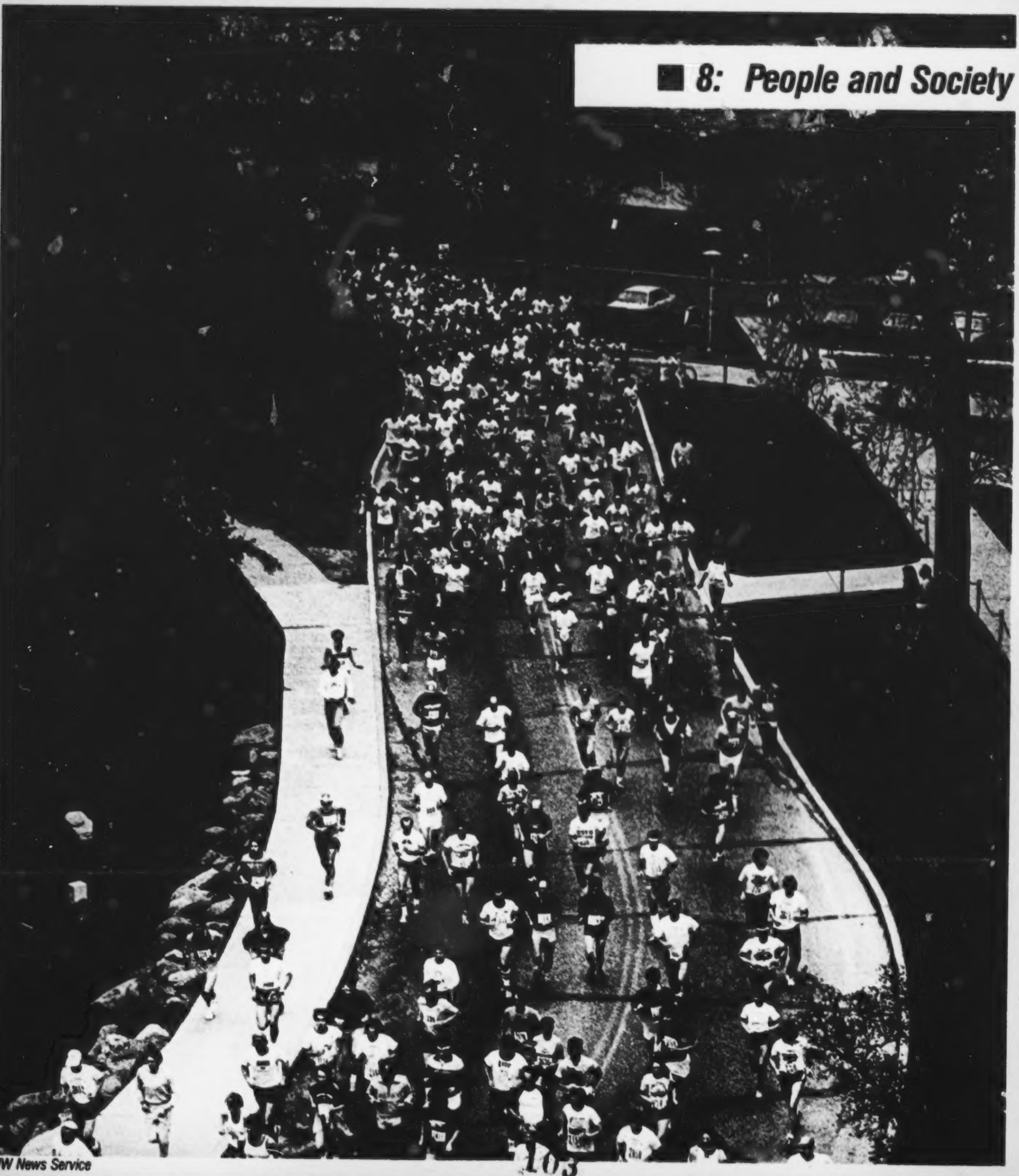
According to Jim Lubner, University of Wisconsin Sea Grant field agent, a hypothermia victim, before losing consciousness, will quickly lose motor control and then become confused. Lubner says this confusion will often cause the victim to resist help.

Nonetheless, rescuers should persevere and get a hypothermia victim out of wet clothing and make him or her as warm as possible. Above all, Lubner says, handle the victim with care and do not rub and massage arms and legs to circulate blood.

> *A hypothermia victim often is in a very fragile state, and jostling that person may lead to cardiac problems. In any event, it's going to force the body to push warm blood out to the extremities before it wants to do that.*

Lubner says if medical aid is more than a half hour away, rescuers should try to rewarm a hypothermia victim themselves. The best way, the Sea Grant agent says, is to crawl into a sleeping bag with the victim and share body heat. And, he adds, do not give alcohol to someone suffering from hypothermia. ■ ***January 1986***

■ 8: People and Society



UW News Service

Sea Talk

In the old days, being shanghaied to the boondocks was not much fun. But minding your Ps and Qs could make you a proper jack tar.

The English language owes many of its common expressions—such as "minding your Ps and Qs," "knowing the ropes" and being "three sheets to the wind"—to seafarers and sailors. Familiar words like bootlegging, posh, scuttlebutt and skylarking also have their origins in the language of the sea.

For example, the expression "tapping the admiral" means having a drink. It dates back to the battle of Trafalgar when Admiral Horatio Nelson was mortally wounded by a musket ball. Rather than being buried at sea, he was preserved in a barrel of rum and shipped back to England. When the barrel was finally opened, the admiral was there but the rum was gone.

"Mind your Ps and Qs" was originally a warning to a drunken sailor. In his home port, a sailor usually had a charge account at the local tavern. The bartender would keep a tally of pints and quarts of beer the sailor consumed, writing P for pints and Q for quarts on a chalkboard. If a sailor didn't keep his wits about him, he might pay for more quarts than he actually drank.

Sailors were sometimes called "jack tars" because they wore their hair long and secured it back in a pigtail with tar. The large bib that sailors wear on their backs today came about originally to keep tar off their shirts.

The word "posh" is also seafaring jargon. Actually an acronym, it stood for port out and starboard home. This indicated on what side of the ship distinguished people should have their cabins for maximum shade.

And finally, the expression "knowing the ropes" was one way a captain could describe what a sailor had learned on the journey. But in those days the expression meant the opposite of what it means today. It was another way of saying that the sailor had learned practically nothing.

■ ***December 1986***

An Anthropologist's Dilemma

Anthropologists who study primitive cultures have a problem: Should they help remote tribal communities cope with threats to their traditional ways of life?

Cultural anthropologists usually try to live quietly among the tribes they study. They hope the people will not react to an alien presence and begin to alter their customs, beliefs and practices.

But anthropologists find it difficult not to take part in community life. After an outbreak of measles, a compassionate scientist may give vaccinations. If a child falls into a fire, a scientist may end up treating the victim with modern medicines instead of standing back and observing more primitive treatment and attitudes.

But the dilemma is even more far-reaching. Should an anthropologist intervene on the tribe's behalf if land and mineral exploitation threatens tribal lands?

John Yellen is an anthropologist at the National Science Foundation in Washington, D.C. Yellen notes that logging, mining and agricultural development threaten to deprive 200,000 Indians living in the jungles of Brazil of their land and traditional way of life.

> *Very often you end up with a moral dilemma: On the one hand, you think, 'Gee, I want to leave things alone'; on the other hand, you see things happening that you're concerned about and you think shouldn't be happening.*

Yellen says several loose-knit organizations of anthropologists are trying to address this concern. One group called Cultural Survival, based at Harvard University, has helped persuade the World Bank to fund only development projects that are compatible with the welfare of indigenous peoples.

But anthropologists still face the dilemma: When should they stop being quiet observers and intervene in the lives of the people they study?

■ ***July 1987***

Flat Earth Flattery

The theory that the world is flat never had a big following, even in 1492.

When Christopher Columbus sailed west from Spain five centuries ago, people thought the world was flat and ships would fall off its edge if they crossed the Atlantic Ocean. That's what many of us learned in grade school, and it's a gross exaggeration.

University of Wisconsin-Madison geographer David Woodward says few medieval scholars actually believed the Earth was flat. But he says we have all heard that theory because of offbeat intellectuals from the Middle Ages.

Two of them, prominent Christian scholars named Cosmas and Lactantius, said the Earth was flat, the Bible proved their claim, and anything to the contrary was heresy.

Woodward says we have all heard about their theory because they were unusual, not because their views were well received.

> *We know about people like Cosmas because the historians have tended to emphasize the unusual in the medieval period. In fact, during his own day, Cosmas was regarded as a second-rate scholar. So here is an example of an erroneous idea being blown up out of all proportion because it happens to be of interest to historians, but it does not reflect the main thread of thinking about the shape of the world and the distribution of earth and water on its surface during the Middle Ages.*

Woodward is compiling a six-volume history of map making. The idea that the Earth was spherical began with the ancient Greeks, Woodward says, and it did not die out during the Middle Ages. He says the myth that the flat-Earth theory was once widely believed began with a biography of Christopher Columbus written in the early 1800s. ■ ***May 1988***

The Mystery of the Mounds

High atop the Mississippi River bluffs near Marquette, Iowa, lies one of the ancient mysteries of the upper Mississippi Valley—the centuries-old Indian mounds at Effigy Mounds National Monument.

Nearly 200 prehistoric mounds have been preserved by the National Park Service. Twenty-nine are effigy mounds, intriguing banks of soil built in the shape of birds and animals. Who built them, and why?

The effigies were built between 600 A.D. and 1400 A.D. in parts of Iowa, Wisconsin, Minnesota and Illinois. Of the 3,000 to 4,000 constructed, only about 20 percent still exist.

The mound builders were nomadic woodland people who lived in small family groups and wandered across the countryside, living off the land. One family may not have traveled more than 10 or 15 miles in an entire lifetime. Why they built the effigies remains a mystery, but there are some tantalizing clues.

Most effigies are found near major sources of water, the first places where food would appear in the spring. And the emblematic mounds are found only in a zone of transition between the prairies of the South and West and the great forests of the North and East. Here the two environments mixed together, providing a large supply of plants and animals for food. Outside this zone of transition, effigies are simply not found.

It's thought the effigies may have served a religious purpose. Some were used for burial, but others contain no human remains or artifacts. What is known is that the mound builders disappeared from the Mississippi River valley about 150 years before the first European explorers arrived, taking the secrets of the mounds with them. Where they went, and why, no one knows.

■ ***March 1983***

Travel Expenses

The way Americans get around costs us more than we think.

City buses, passenger trains and other forms of public transit are frequent targets of budget cutters who resent having to subsidize them. Likewise, taxpayers sometimes consider bicycle lanes and even sidewalks luxuries.

But Mark Hanson says if people took a hard look at the public costs of getting around in private cars, they might see things differently. Hanson is an assistant professor of environmental studies and urban planning at the University of Wisconsin-Madison. He estimates that for every vehicle on the road in Wisconsin, state taxpayers shell out more than $100 a year just to build and maintain highways and enforce traffic laws. That does not count vehicle registration fees and gasoline taxes.

Hanson's estimate does not include public expenditures on air pollution, traffic accidents, health care for the injured, and other indirect costs of car travel. All this adds up to what Hanson considers a whopping subsidy of its own.

> *When I look at discussions of what we should do about mass transit or bicycles or walking, provisions for pedestrians or whatever, I'd like to see the different modes—this includes light rail—put on a level playing field. If we want to subsidize the automobile at the level we're doing it, then let's subsidize all the other modes and then let them compete. If we want to get rid of the bus subsidy, fine, let's get rid of the subsidy for all the other modes as well and then see what happens.*

Hanson says putting all forms of transportation on "a level playing field," as he puts it, might change the way Americans choose to get around.

■ ***June 1987***

Building a Science

Half a century ago, wildlife managers relied more on good intentions than on hard science. But in just a few years, one man changed that.

No science can trace its roots back to just one person. But wildlife ecology can come close.

At the turn of the century, no field of science dealt with the relations between animals, land and people. There were fields like zoology and geography, but nothing that combined them. Then, in the late 1920s and early '30s, Aldo Leopold fused these distinct fields into a new discipline—wildlife ecology. This year is the hundredth anniversary of Leopold's birth.

Though he was trained as a forester, Leopold's years with the U.S. Forest Service crystallized his ideas about the relations between people, land and wildlife. In 1933, Leopold put those observations into a book titled *Game Management*. This was the critical thesis around which wildlife ecology grew.

Robert McCabe, a retired professor of wildlife ecology at the University of Wisconsin-Madison, was one of Leopold's early graduate students. He describes Leopold's influence:

> *He is regarded as the father of wildlife management. He was in on almost every aspect of the development of game management thought. And his book really coalesced all of these ideas. And today, the basic concepts of that book are as good as they were the day they were written. All that has happened is that in the intervening years we've produced scientific data to support those concepts.*

In 1939, the University of Wisconsin-Madison created the first Department of Wildlife Management in the world; it was later renamed the Department of Wildlife Ecology. Aldo Leopold was its first professor. ■ ***March 1987***

■ The Snowflake Man

There's a unique old farmhouse in the hills of northern Vermont, distinguished from all the rest by a large metal snowflake at the peak of its roof. This is the house where Wilson Bentley made photographic and scientific history by taking the world's first picture of a snowflake almost 100 years ago.

Bentley's remarkable technique has never been matched. Working in an unheated shed, he would sift through a collection of flakes, spear a perfect crystal and transfer it to a microscope slide. Careful never to breathe on the delicate specimen, he would rapidly slip it under his microscope-camera and take a picture. During his lifetime, Bentley photographed more than 5,000 snowflakes. The prints have been used not only by scientists but also by jewelers and designers.

Whatever inspired a shy dairy farmer to dedicate his life to the cold pursuit of snow? Amy Hunt, Bentley's niece, says her uncle's infatuation with snowflakes began at the age of 15 when his mother gave him a microscope.

> *When he noticed them with his microscope, he thought that they were so beautiful. And he said that they'd come from 'cloudland' and that was God's gift to the world, to enjoy these beautiful snowflakes.*

Mrs. Hunt, who is 84 years old, fondly remembers her uncle's perseverance.

> *He never would give up until he got his perfect snowflake, which was in 1885, when he did his first one. My folks were in Florida at the time, and they were trying to get him to go down, but no way, he couldn't leave that snow.*

There's an ironic twist to the story of the man who became known as Snowflake Bentley. After a lifetime of fascination with snow, he died of pneumonia in the winter of 1931—an illness that some say he got walking home in a blizzard.

■ ***February 1983***

■ A Parks Pioneer

What better monument could there be to a man who believed nature rejuvenates the human spirit than a lush, beautiful park?

There are many such monuments to Frederick Law Olmsted. He designed some of the nation's best-known parks, and a century later, they remain a tribute to his uncommon foresight.

Olmsted was born in Hartford, Connecticut, in 1822, the son of a well-to-do merchant. He tried his hand at engineering, farming, writing and publishing. But he made his biggest mark as America's first landscape architect.

In the late 1850s, Olmsted and a partner turned 840 acres of swamp, rocks and hills into a now-familiar landmark, New York's Central Park. There had been city parks before, but none of this magnitude or beauty. It was an instant success. Twenty-five thousand people a day flocked in to relax and play as soon as it was completed.

Olmsted firmly believed city dwellers in this young but rapidly growing nation needed large, natural, open spaces to relieve the pressures of civilized life. He lobbied hard to protect such places, and he won many supporters. Eventually, he was asked to design and supervise the creation of more than three dozen major parks in cities ranging from Boston to Louisville to Milwaukee.

Always, Olmsted chose to work in harmony with the landscape rather than against it. He insisted on lots of greenery. He liked curving paths and roads with new vistas at each turn. He tried to keep buildings from intruding.

Perhaps most important, Olmsted believed in looking to the future. He sowed seeds not just for his contemporaries but for many generations to reap. ■ ***August 1982***

■ Leap of Faith

A 17th century pioneer in anatomy and geology spurned fame and fortune to minister to Europe's poor.

Today's science stands on a foundation laid in the 17th century. Scientists such as Galileo, Newton and Halley replaced speculative and mystical notions with experimentation and proof. But they were often caught between their discoveries, powerful church authorities and their own religious convictions. As Galileo found at his trial by the Inquisition, science and religion were not always compatible.

Another casualty of this conflict was Nicolaus Steno, a devout Danish scholar born in 1638. In his early twenties, Steno traveled around Europe demonstrating his skills in dissection and his knowledge of human anatomy. He was the first to accurately describe the workings of the glands, muscles and heart. His reputation earned him the admiration and financial support of Italian royalty.

That royal interest led to another of Steno's scientific achievements. When a duke sent him a shark's head to study in 1665, Steno noticed that the shark's teeth resembled fossils he had seen in the Italian countryside. To explain how those teeth and other marine animal parts became sealed in rock, Steno established fundamental principles of geology.

This was no small feat in the 1600s. Only the Biblical account of the earth's history was widely accepted in Europe, and fossils were not thought to have come from living things. Some historians say this conflict raged in Steno's own mind and ultimately drove him to the Church. He became a priest at age 36 and preached among the poor of northern Europe. He never practiced science again, but even in his short career, Nicolaus Steno pioneered careful methods of observation essential to modern science. ■ ***June 1986***

■ The Tree Huggers of India

More than 250 years ago, a young girl in India threw her arms around a tree in desperation. Shielding the tree with her body, she hoped to prevent the maharajah's axemen from cutting it down. Instead, the girl and 363 other protesting villagers were themselves felled before the maharajah stopped the slaughter.

These early martyrs of forest conservation inspired what was called the chipko movement. In India, "chipko" means "to embrace."

Today, population pressures and a desperate need for timber and fuel are causing the forests of northern India to be over-harvested. For these same reasons, neighboring Nepal is currently losing about 3 percent of its forests each year. A United Nations study predicts this trend will turn the mountainous regions of these two countries into desert and bring flooding to central India by the end of the century.

In response, a modern version of the chipko movement has sprung up. For 20 years, the present-day chipkos—mostly women—have been demonstrating against the loss of forests in northern India. These women and their children have been literally hugging trees to stop the axes and chainsaws from cutting them down. The chipkos also urge massive tree-planting programs to provide jobs, restore the forests and anchor the eroding soil.

All this has earned the respect of the Indian government, and forest clearing has been suspended temporarily in some regions.

Other tropical forests such as those in South America and Africa are also threatened. This year the World Wildlife Fund and the International Union for Conservation of Nature is campaigning to save the world's forests. Helping to lead the way are the chipko tree huggers of northern India.

■ ***March 1982***

A Matter of Proportions

A leading environmental scientist says population is growing fastest in parts of the world that can least support it.

After years of slow but steady decline, the world population growth rate rose last year. A private organization called the Population Reference Bureau in Washington, D.C., says the growth rate now stands at 2.8 percent a year. It may not sound like much, but at that rate world population would double to more than 10 billion by the year 2030. And most of the additional people would live in impoverished developing nations.

Peter Raven directs the Missouri Botanical Garden in St. Louis and is a leading spokesman on international environmental issues. He says citizens of industrialized countries must understand that they're members of a fast-shrinking minority.

> *For somebody born in 1950 in an industrial country, there would have been two people living outside of industrial countries for one of him or her. At the end of that person's life, or toward the end, in 2020, there will be five people living outside the industrialized countries of the world for every one of them.*

Raven says those numbers do not bode well for the 20 percent of the world's population that currently enjoys a high standard of living.

> *That's a change in global proportions, which makes the fact that we in the industrialized countries control about 80 percent of the total gross national product of the world, about 80 percent of the industrial energy, and about 80 to 95 percent of all the materials that go to make up the standard of living, a serious inequity and one that will have increasingly obvious repercussions.*

Raven says those repercussions include increasing tensions between the haves and have-nots of the world. ■ ***May 1987***

Feeling the Strain

"Short of thermonuclear war itself, population growth is the gravest issue the world faces over the decades immediately ahead."

The words are those of Robert McNamara, former U.S. defense secretary and retired president of the World Bank. But the idea is shared by many people concerned about international development.

Leaders of Third World countries such as Egypt, India, Mexico and the Philippines worry openly that population may be their biggest obstacle to security and prosperity. The population of these and other developing countries has doubled since World War II and probably will double again in the next 17 to 35 years. McNamara and others say industrial nations like the United States cannot turn their backs on the problem. Its ripple effects are felt throughout the world. Countries that cannot support their populations often fall into deep foreign debt; suffer high unemployment, food shortages and poor living conditions; and see the gap between the rich and the poor grow wider.

Social scientists warn that those conditions give rise to the sort of political turmoil, both domestic and international, that's so evident today in Latin America and Africa. And this turmoil threatens the security of the rest of the world.

When ecologists like Paul Ehrlich first warned of a ticking "population bomb" in the early 1970s, they expressed the problem largely in biological terms. There was a limit, they said, to the number of people the Earth could hold, and when the population reached that limit, there would be widespread famine, disease and death.

It seems now that the dangers of overpopulation are much more complicated. Whether or not there's a biological "upper limit," the world's economic, social and political systems all feel the strain of too many people. ■ ***January 1984***

Crisis? What Crisis?

End of the world getting you down? Simon says, "Relax."

Julian Simon angers environmentalists when he says the world is not overpopulated, is not dangerously polluted, and will not run out of resources. In fact, Simon, a University of Maryland business professor, believes quite the opposite. He claims that more people mean more producers and consumers to fire up the economy and more brains to think up new ways to solve problems and create new things. Put them in a free market, he says, and prices and profits will ensure a steady supply of the good life.

His critics call Simon's ideas fairy tales. They say he overlooks evidence that parts of the world have more people than they can feed and that many nonrenewable resources are being depleted. But Simon considers dire warnings about the environment unnecessarily gloomy.

> *I'm not saying that all is well everywhere, and I don't predict that all will be rosy in the future: Children are hungry and sick, people live out lives of physical and intellectual poverty and lack of opportunity, war or some new pollution may finish us off. What I am saying is that for most relevant economic matters that I've checked, the aggregate trends are improving rather than deteriorating; not that things are good, but that they've been getting better.*

And they're getting better, says Simon, because people throughout history have struggled to make them better. He says the evidence is all around: Pollution levels are dropping, and raw materials are getting more affordable all the time. If resources were getting more scarce, he asks, how could their prices go down? Environmentalists say Simon uses only those facts and figures that support his case. Simon denies that and insists that people always find a way to get by. He says he has faith that they'll continue to do so.

■ ***September 1987***

The Promise

Biotechnology, which makes it possible to change the genetic makeup of living cells, is barely a decade old. But scientists say it promises to revolutionize medicine, agriculture and industry.

By transferring genes from one cell to another, scientists can endow living organisms with new abilities. Implanting the gene that produces human insulin in a bacterium, for example, has made it possible to easily and cheaply mass-produce insulin, which is so important to diabetics.

Richard Burgess, director of the University of Wisconsin-Madison's new Biotechnology Center, says genetic engineering holds unlimited potential.

> *We can do things now that we couldn't dream of doing several years ago. Almost anything you can imagine doing that involves a gene—isolating a gene, changing a gene, expressing that gene at high levels, purifying the enzymes—anything you can think about doing is feasible.*

Burgess, a cancer researcher, says biotechnology has triggered a revolution in the diagnosis of certain diseases. And he expects new, more effective treatments to follow, including, perhaps, a cure for cancer. He also thinks farms and factories will soon benefit from genetic engineering. Burgess says more productive crops and nonpolluting industrial processes are on the horizon.

Despite all the promise of biotechnology, critics have raised questions about its potential for negative environmental, social and economic repercussions. Some have even challenged the ethics of transferring genes between species.

Burgess believes most of their fears are exaggerated. He says scientists have proceeded—with caution—because the potential for good in biotechnology far outweighs the risks. ■ ***May 1985***

Miracle or Nightmare?

Scientific miracle or impending nightmare? Jeremy Rifkin says genetic engineering spells trouble.

Some scientists claim biotechnology could one day eliminate disease and starvation. Economist and author Jeremy Rifkin says these goals are admirable, but he questions the wisdom of tampering with nature's designs.

> *I believe each species has an essential nature, an integrity, a self-worth that's imprinted into its genetic code, and that it is irresponsible of us to attempt to rearrange those codes after millions of years of natural development.*

Rifkin, whose lawsuits have delayed several genetic research projects, claims biotechnology is reducing life to a set of design principles.

> *And it raises some troubling questions. What are the criteria, for example, for what is a good and bad gene? Efficiency? National security? Those are cultural values, not biological rules. Then the ultimate question is raised: Who do we entrust with the authority of deciding what is a good and bad gene?*

Rifkin's critics point out that nature has produced hardships such as disease and famine. They say science should work to overcome human suffering. Rifkin agrees, but he believes the long-term costs of genetic engineering will outweigh its potential benefits.

> *You know, we rushed into the nuclear revolution without any questioning, and we rushed into the petrochemical revolution without any long-term look at the costs. And now our children's generation is reaping a very terrible legacy in regard to everything from nuclear power plants that cannot be decommissioned to chemical waste dumps that cannot be cleaned up. We owe it to ourselves this time around to ask the hard questions at the beginning of the technology.*

■ ***May 1985***

Swords into Plowshares

Guns or butter? For many nations, the choice is very real.

What makes a nation secure within its borders? Not just military hardware, according to Michael Renner.

Renner is an expert on international relations at the Worldwatch Institute, a private research organization in Washington, D.C. He contends that governments routinely risk their national security by defining it strictly in military terms. In the long run, Renner says, *economic* and *environmental* stability may be more important than military might to a nation's well-being.

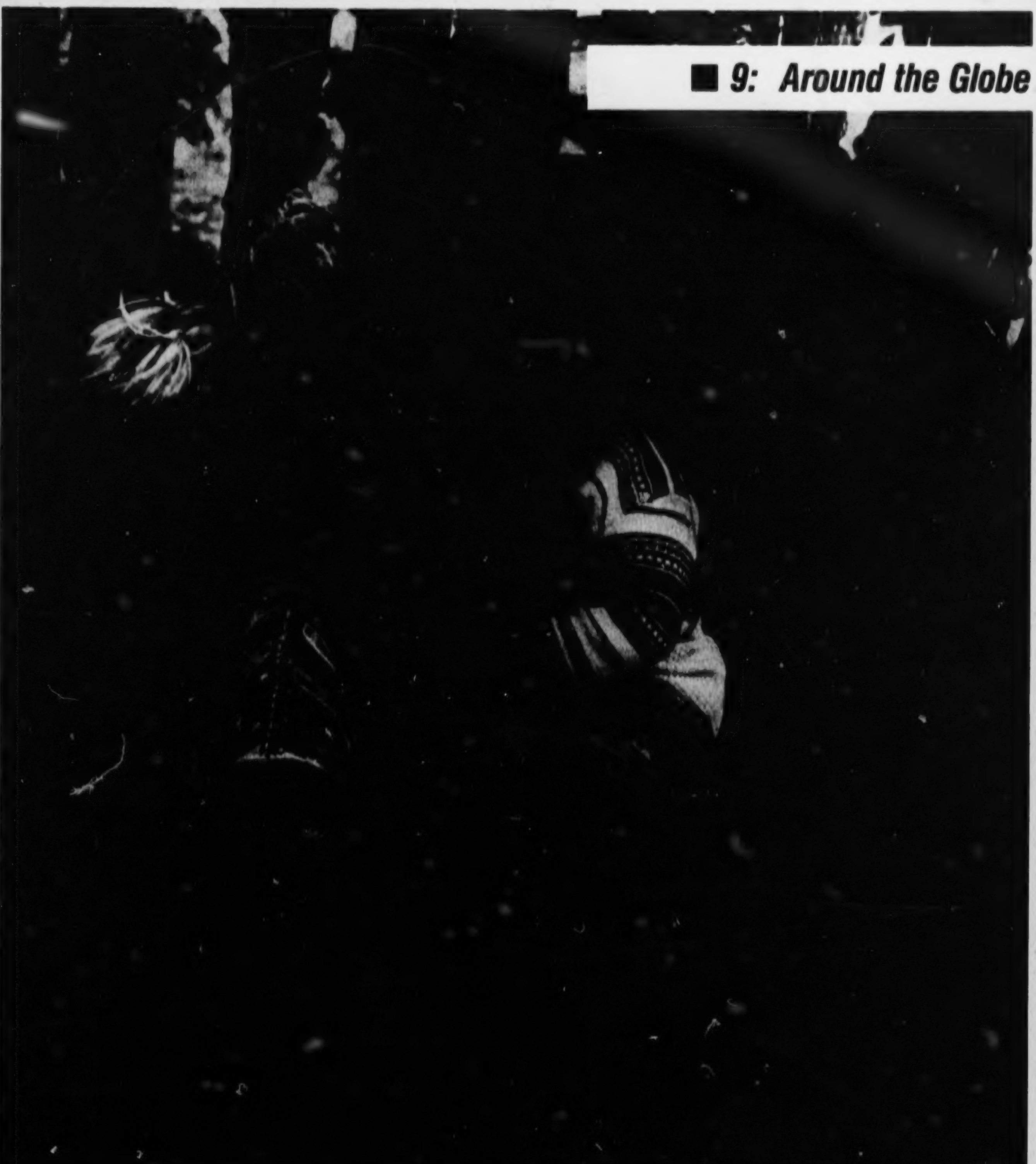
Ethiopia is an example. During the 1980s, famine devastated this eastern African country. Renner says the Ethiopian government was too preoccupied with a civil war to head off the disaster.

> *If Ethiopia had spent something like $50 million a year on halting its soil erosion and deforestation, it could have avoided the much larger costs that it incurred in the early and mid-1980s in the form of declining agricultural productivity and mass starvation.*

Instead, says Renner, the Ethiopian government spent $50 million every two months to arm itself against anti-government rebels. Ironically, the rebels gained strength and determination as Ethiopia's environment deteriorated. Renner says starving people lost faith in the government and looked to the rebels for help.

The Worldwatch expert says he does not mean to say the governments must choose simply between arms and the environment. He says they must deal with threats as they perceive them. But in their drive to arm themselves, some may neglect the land and water that ultimately sustain their people. ■ ***August 1989***

9: Around the Globe



Michael Kienitz

■ Thailand's Sinking City

Overpopulation, pollution, flooding and food shortages are problems all over the world. But in many developing countries, these problems are aggravated by shortages of money and technical knowledge.

Bangkok, Thailand, for example, with an estimated 5.4 million people, subsists on an annual budget of only $170 million. By comparison, New York City has a budget 100 times larger.

Bangkok, a city handicapped by a mushrooming population and poor urban planning, suffers from severe flooding. During the rainy season, water runs more than three feet deep in some places and often stands in pools for months. But flooding is just a symptom of bigger problems.

Thirty years ago, this coastal city made way for automobiles by filling in most of the canals that branched off a nearby river. This shut off a natural drainage system. Then, with the increasing population, there was a greater need for drinking water. The city dug 1,000 additional wells, but that severely depleted the water table that helped support the land upon which Bangkok is built. As water was taken out, the land subsided. Today the city is three feet lower than it was 30 years ago. Bangkok is now sinking as much as four inches a year, and experts warn that in 20 years, the city could sink below sea level and become uninhabitable.

This year, Thailand authorized $16.7 million to begin dredging a canal and building a dike and floodgates. But officials believe that the project will not be complete for several years. Given its ever-increasing population and a lack of money, Bangkok—Thailand's capital city—faces a most precarious future. ■ ***June 1983***

■ Pushing the Limits

Cairo, once the mystical city of a thousand minarets, has changed drastically under the crush of millions of people. Like many cities, the Egyptian capital struggles to provide its citizens with housing, food, clean water and other basic human needs. But people's demands far outstrip Cairo's ability to meet them.

Designed to hold a million and a half residents, the city today has more than nine million people and gains another 800 every day. Its Giza district is three times as densely populated as Manhattan, and in Giza, people are crowded into four- and five-story buildings, not skyscrapers. Many of Cairo's poor build shacks on roofs of other buildings. Hundreds of thousands live in the city's huge cemeteries, usually with no services at all.

In this overburdened city, human need overshadows questions of environmental protection. With sewage flooding the streets, no one asks if the Nile River is polluted. Yet in tackling Cairo's social problems, Egypt is starting to salvage the city's natural environment. The government is working to curb Cairo's population growth, repair and extend its sewer and water systems, and improve its housing.

Egypt's citizens are helping too. One television commentator spearheaded the creation of an Egyptian environmental agency. Some people have helped the environment by helping themselves. Forty thousand families make a living collecting, sorting and selling trash from Cairo's upper-class households.

But the city's environmental problems are far from solved, and the main obstacle is money. One important government agency, Egypt's Ministry of Planning, has stated flatly that it cannot afford to worry about protecting the city's environment when it faces so many other urgent problems.

■ ***December 1983***

■ Supercity

Jose Lopez Portillo, the president of Mexico, has called it "the most absurd thing that ever happened." Portillo was referring not to an event but to the capital of his own country: Mexico City.

First settled by the Aztec Indians more than 600 years ago, Mexico City has mushroomed this century into a metropolis of 14 million people—twice the size of New York City. And it is adding the equivalent of the population of Milwaukee—about 700,000—every year.

Urban experts say Mexico City may swell to more than 30 million people by the year 2000, making it by far the largest city in the world.

Hundreds of poor peasants and job hunters from small towns stream into the city each day. They hope to find work and prosperity for their families. Some do, but many more do not, and so Mexico City is a place of stunning contrasts. It has a grand boulevard lined with great buildings, glittering monuments and beautiful greenery. It has luxurious homes, fashionable shopping centers and elegant restaurants. But only a few miles distant, multitudes of families still live in rickety shacks and caves along dirt roads piled high with garbage. Many have no water or sewer systems. Some are literally starving to death. Even those who prosper must cope with huge traffic jams, severe air pollution and frequent breakdowns in city services.

Some urban planners blame Mexico City's woes on the local government, which did nothing to control the city's growth for decades. Now, they say, it is too late to solve the city's problems; the best hope anyone can have is to make those problems more manageable. ■ ***July 1982***

■ Grim Harvest

In a major nuclear war, an estimated one billion people in the northern hemisphere could be killed outright. But a recent study predicts far more would starve to death.

According to a report by the Scientific Committee on Problems of the Environment, far more people would die of starvation following a large-scale nuclear exchange than from bombs.

The committee, part of the Paris-based International Council of Scientific Unions, stressed the fragile nature of the world's agriculture. The 200 biologists who contributed to the report agreed that a nuclear war would interrupt most agriculture in the northern hemisphere for almost a year and impair it for years thereafter.

Several factors account for this dire prediction. Proponents of the "nuclear winter" theory claim unlimited nuclear war would produce persistent clouds of dust and smoke that could lower temperatures drastically. The biologists point out that even a small drop in temperature would reduce corn yields in the northern hemisphere. In fact, just a three- and-a-half-degree drop through the growing season would cut grain production 50 percent in Canada and the Soviet Union. And a one- or two-day cold spell could wipe out rice harvests. Cereal grains such as these make up 70 percent of the world's food supply.

Computer models of the world's climate also suggest that the aftermath of nuclear war would temporarily cut sunlight in the northern hemisphere by as much as 90 percent, which would seriously inhibit plant photosynthesis. Other environmental damage would include rain that's more acidic and toxic compounds in the air from widespread fires.

A Toronto University scientist who helped prepare the committee's report predicts its message will increase public pressure to reduce the world's nuclear arsenal. ■ ***November 1985***

■ Aftermath of War

As Vietnam attempts to recover from three decades of war, it is struggling to prevent an ecological catastrophe.

The war in Vietnam may be history, but its scars remain. Twenty-five million tons of bombs were dropped on Vietnam during the fighting. Countless villages and vast tracts of jungle were set ablaze. And much of South Vietnam was sprayed with massive doses of defoliants.

The human toll was tragic enough. But John MacKinnon, a consultant to the Swiss-based International Union for the Conservation of Nature and Natural Resources (IUCN), says the war also wiped out forests, poisoned land with toxic chemicals and harmed valuable fisheries.

All of that, says MacKinnon, compounds a problem Vietnam shares with so many other Third World countries: It has a large and growing population in a relatively small area, and the demand for food, fuel and other necessities is mounting. MacKinnon says the Vietnamese are clearing land for farming and firewood at a rate that will leave them without forests in 25 years. The land they're clearing has relatively poor soil and cannot sustain crops for more than a few years. And in their quest for meat, Vietnamese hunters have diminished the country's wildlife.

The leaders of Vietnam are aware of the problem they face. The government recently embarked on a national campaign to stabilize farm production and conserve soil, plant millions of new trees, create forest preserves and wildlife refuges, and slow the country's population growth.

Invited by the Vietnamese, the IUCN is helping with the campaign. MacKinnon says the situation in Vietnam is perilous but not hopeless. A combination of conservation and ecologically sound development, he says, could give the once war-torn country a brighter future. ■ ***September 1985***

■ Antarctic Disharmony?

For years, Antarctica has been an international laboratory where research takes precedence over politics. But now, the search for oil and precious minerals may disrupt this harmony.

Researchers from 16 nations have conducted experiments in Antarctica for the last quarter century with scientific rather than political imperatives in mind. The Antarctic Treaty of 1961, signed by a dozen nations, proclaimed Antarctica an international laboratory for scientific research.

Many scientists consider the isolated Antarctic continent an ideal natural laboratory. It has the Earth's cleanest air and water—good conditions for biological research. Antarctica has been spared political posturing by the many nations who lay some claim to it partly because the research was not geared toward exploitation of natural resources. But that may soon change. Many geologists believe that beneath the offshore continental shelf of Antarctica lie the Earth's last giant oil reserves. Others think the continent contains large deposits of gold and diamonds.

Many scientists fear once oil and mineral exploration begins in earnest, there will be no stopping the influx of governments and private corporations determined to get their piece of the Antarctic pie. But others claim that the weather and conditions are too hostile, that it would cost too much to drill for oil in temperatures that can drop to 100 degrees below zero and where winds often reach hurricane force.

Conflicts over jurisdiction will be considered when the Antarctic Treaty is reviewed in 1991. But some nations are already attempting to strengthen their position at the bargaining table. Chile and Argentina have even settled a few families on the Antarctic peninsula. ■ ***December 1985***

■ The Unkindest Cut

Brazil is pushing hard to develop the natural resources of the Amazon River basin. Large areas of rain forest are disappearing as a result, and scientists say the forests could be gone in 35 years if uncontrolled cutting continues.

The Amazon basin contains more than half the world's tropical rain forests and the largest variety of plants and animals anywhere. The lush vegetation also helps moderate the world's climate.

But biologist Philip Fearnside of Brazil's National Institute for Amazon Research says the Brazilian government's promotion of mining, forestry and agriculture is causing the forests to be cut at an alarming rate. Fearnside says agricultural development is taking the biggest toll: Brazil is building roads into the tropical wilderness and providing financial incentives for new farm settlements.

Ironically, despite its dense tropical growth, much of the Amazon region is not good for long-term agriculture. Fearnside says farm crops use up all the soil's nutrients within a few years after the trees are cut. The land soon becomes barren and hard and can no longer support either crops or natural vegetation.

But Fearnside says the desire to push back the frontier is deeply rooted in Brazil. Political parties campaign on big promises of land development. Speculators buy land as a hedge against Brazil's 200 percent inflation rate. And the government seeks to raise cattle for export to help pay off its mounting international debts.

Fearnside and other scientists warn that Brazil's push to overcome its economic problems by developing the Amazon basin could have serious long-term environmental consequences. Rare and valuable plants and animals may be driven to extinction, and unwelcome climate changes could reach well beyond Brazil's borders. ■ ***April 1985***

■ Chemical Dependence

Developing countries that try to boost their agricultural production with chemicals may do themselves more harm than good.

Chemical fertilizers and pesticides have multiplied farm productivity several times over in countries like the United States. The so-called Green Revolution is the envy of many Third World countries fighting widespread hunger. Some of them are trying to join the Green Revolution by subsidizing the use of pesticides by their own farmers.

Economist Robert Repetto of the World Resources Institute, a private environmental research organization in Washington, D.C., has studied pesticide subsidies in nine developing countries where the government picks up an average of 44 percent of the farmers' costs of pesticide use.

Repetto says this government support may be a bad idea. He says many Third World farmers who can afford pesticides because of the subsidies don't know how to use them safely. As a result, health and environmental problems, such as farmworker poisonings and groundwater contamination, are common. In addition, indiscriminate use of pesticides is creating populations of pests resistant to chemicals that are supposed to kill them.

Repetto says simply ending government subsidies for pesticide use in developing countries would solve many of the problems. The chemicals would once again be too expensive for most Third World farmers. Pakistan dropped its pesticide subsidies a few years ago, and Repetto says most of the related health and ecological problems have disappeared.

The World Resources Institute economist believes international relief organizations like the U.S. Agency for International Development could do more for the long-term agricultural health of Third World countries by promoting natural methods of pest control and helping those countries monitor and regulate their pesticide use.

■ ***March 1986***

■ Be It Ever So Humble

Housing conditions in many developing countries are abysmal. The United Nations estimates that up to 70 percent of the rural homes in the Third World provide inadequate shelter or lack basic necessities.

Many developing countries have policies geared toward improving housing. But Bruce Stokes, a former researcher with the Worldwatch Institute in Washington, D.C., believes some of the plans are ill-advised.

Some poor nations, trying to emulate more affluent countries, are building new dwellings out of cement. Unfortunately, says Stokes, cement homes require lots of material and sometimes have hidden costs that can raise the price of construction unexpectedly. This is a serious problem in countries where money is scarce and investments in industry and farming take precedence over those in housing.

Stokes says Third World countries would be better off adapting traditional building materials to modern needs. For example, he says adding small amounts of cement to mud and straw makes earthen bricks that are stronger and that insulate better. And mixing in a little asphalt makes the bricks water-resistent.

Stokes also recommends creating village woodlots with fast-growing trees. He says they would provide timber for roof beams and wall supports, which are needed even in homes built of mud. And they would increase stocks of firewood, which is in short supply in some countries.

Stokes believes innovative use of traditional materials should underlie all plans to improve housing in developing countries. It's less expensive than other options, he says. And since mud, thatch and wood are available almost everywhere, their use would lessen the need for imported materials and keep more of the money in developing countries at home, where it is desperately needed.

■ ***May 1983***

■ A Grand Plan

Third World countries are sometimes tempted to do things on a grand scale to catch up with wealthier nations. But if undertaken too hastily, their development schemes can go awry.

Witness the case of Sri Lanka. This small island nation off the coast of India imports 40 percent of its food and nearly all of the fuel it uses to generate power. But Sri Lanka is struggling to become more self-sufficient. The centerpiece of its struggle is a scheme to build four huge dams to draw hydroelectric power and irrigation water from the Mahaweli River. The government embarked on a crash program seven years ago to build the dams by 1986. Four western countries agreed to help finance the job.

Half a decade later, two of the dams are built and the other two are under construction. But their estimated cost has more than doubled in the past five years to $2.5 billion. The Sri Lankan people, already strapped for cash, are bearing the burden through cutbacks in public services.

Perhaps worse, the potential benefits of the Mahaweli project are threatened by erosion of bare hillsides along the river. Farmers have cut most of the trees there to grow tobacco and other crops. In its haste to build the dams, the government overlooked warnings that if new trees were not planted, erosion could clog the irrigation canals with silt. The government began a tree-planting program in 1981, but it's proceeding very slowly and draining the public till even more.

The Mahaweli project may yet deliver on its promise of economic hope for the people of Sri Lanka. But critics point out that a revitalization of hundreds of now-unused small hydro dams around the country might have been a less expensive, more environmentally sound option.

■ ***September 1984***

The Price of Growth

Poland has become an industrial power since World War II. It also has become one of the world's most polluted countries.

Once a simple farming country, Poland is now the 11th most industrialized nation in the world. Steel, coal, chemicals and shipbuilding have surpassed agriculture in Poland's economy in the past 30 years, and the farming that remains depends more on chemicals and machinery than ever before.

Poland has paid for rapid modernization with widespread air and water pollution. As much as three quarters of the country's sewage flows into rivers untreated, and studies suggest that half of Poland's river water is unfit for consumption by animals. Streams once rich with salmon are now devoid of animal life.

Popular recreation spots along the Baltic Sea also have suffered. Poland's major rivers flow into the Baltic and carry sewage and industrial wastes that render the coastal waters unfit for swimming.

Air pollution has taken its toll, too. Poland derives 80 percent of its energy from coal, and that produces high levels of sulfur dioxide pollution thought to cause acid rain. Scientists believe severe air pollution is killing Polish forests and damaging historic buildings. They also fear the public health consequences of the dirty air.

Poland plans to continue its industrial buildup, but there are signs the country is waking up to its plight. Since 1980, environmental activism has spread across Poland, and the government seems willing to tolerate it. In fact, Poland's State Environmental Protection Council recently promised to make environmental concerns a priority in future economic plans. The government warned, though, that it will do only as much as it can afford. And in a country beset with a huge national debt, that may not be much. ■ ***January 1986***

Another Japanese Success

What are Japanese farmers doing in the heart of Brazil? They're showing everyone else how to farm.

Japanese farmers who immigrated to Brazil in the 1920s have found a successful formula for agriculture in the tropics, where many farming ventures are marginal at best.

About 2,000 of the Japanese farmers live in the Amazon jungle. They grow some annual crops like rice, corn, and squash. But their success lies in perennial crops that yield high-value products like rubber, cacao and spices.

Christopher Uhl, an ecologist at Pennsylvania State University, says the Japanese make a good living off the infertile soil that characterizes much of the tropics. Their perennial crops are suited to the land and they also have fewer troubles with pests. And the Japanese farmers do not have to move every few years, unlike many of their neighbors who grow annual crops and, when their land is exhausted, need to clear more forest for new fields.

Uhl believes other tropical farmers could follow the Japanese example. He says that would be for their own good and for that of the forests, which are rapidly giving way to sprawling farms and cattle ranches.

> *It's rather revealing to see a Japanese farm, which might be at best 10 acres in size—that would be a very large operation—side-by-side with a 3,000-acre ranch, and the Japanese farmer is making much more money. It just illustrates how intensive farming of the right crop, in this case intensive farming of a high-value crop, can more wisely use land.*

The Japanese success in Brazil is more than just luck. Uhl says the farmers are hard workers and good ecologists. ■ ***January 1987***

Dangers of Development

In their rush to develop industry and agriculture, the nations of the Third World have also rushed into serious problems with occupational health.

Desperate even for meager wages, people in Asia and South America take jobs in factories and fields that expose them constantly to hazardous dust, chemicals, gases and noise. Most are unaware of the hazards until it is too late.

Textile workers in India, for example, suffer from a spate of occupational diseases. The Indian government estimates that one out of five has byssinosis, or brown-lung disease, a debilitating respiratory ailment that occurs in people who inhale cotton dust for several years. Textile workers also breathe gases from dyes and other chemicals that can cause heart disease, nervous disorders and even death.

Because the majority of workers in developing countries are still farmers, the most pervasive occupational hazard may be pesticides. Hard statistics are far from complete, but David Bull, author of a book on the problem, estimates that at least 375,000 people in the Third World suffer from pesticide poisoning each year, and 10,000 of those victims die. The tiny island nation of Sri Lanka alone has reported a thousand pesticide-related deaths in one year.

Illiteracy and a lack of information about workplace hazards make occupational health problems all the more ominous in developing countries. World health officials say that even where people are aware of health threats in factories and fields, they have difficulty finding out what to do about them. Stepped-up research and public information programs offer some hope, but with the rapid pace of economic growth in the Third World, keeping development healthy and safe is a monumental task. ■ ***January 1984***

Tragedy of a Continent

Most Americans cannot imagine what it's like to starve. But television has given us glimpses recently of the starving poor in Africa. And they remind us that not everyone is as well off as we are.

The famine in Africa should not come as a surprise. Lester Brown of the Worldwatch Institute warned three years ago that conditions in sub-Saharan Africa were ripe for disaster. Brown said soil erosion, the cutting of forests and excessive cropping had reached the point where the land could no longer support the swelling population. Crop yields were declining, and many of the affected countries were too poor to import the additional food they needed. The United Nations, the World Bank and other international organizations agreed that Africa was in serious trouble.

By mid-1983, severe drought had compounded the misery. Scattered press reports in the United States told of devastated crops and livestock. By last March, news trickled in that thousands of Africans were dying daily in 24 drought-stricken countries. An estimated 150 million people were in peril. That's equal to two-thirds of the population of the United States.

Publicity in the last few weeks has bolstered relief efforts. Thousands of tons of grain and other foods have been shipped to Africa, and more will follow. But the conditions that led to Africa's famine are complex and deeply rooted. Besides environmental problems, civil and international strife and government mismanagement have been blamed. Emergency food shipments may help in the short run. But a recent report prepared for the U.S. House of Representatives' Committee on Foreign Affairs says major improvements in the African food situation will take time, if they happen at all. And it seems certain that hundreds of thousands more—if not millions—will starve before the tragedy ends. ■ ***November 1984***

■ Ecological Refugees

Large-scale environmental damage is creating a new class of desperate people: ecological refugees.

Millions of people have abandoned their homes in drought-stricken regions of Africa. They've fled the famine that ravaged Ethiopia, Chad and other countries and that still plagues nations such as Mozambique.

The World Bank blames natural climate change for the famine, but it says human activities intensified the problem. Tree-cutting, grazing cattle and poor farming practices helped render many areas uninhabitable.

Noel Brown of the United Nations Environment Programme says mass exoduses may become common if large-scale environmental problems continue. Brown cites Haiti, a poor Caribbean country, as an example. Haitian refugees risk their lives daily in makeshift boats to escape poverty and political turmoil.

> *The Haitian boat people are as much ecological refugees as they are political refugees. That is, you find a situation where the local environment has become so strained that the agricultural backbone is broken and people are looking for escape.*

Brown says mass human migration may incite conflicts between nations.

> *The question of space for population, living space, becomes a major social problem and a political problem. And then states find that their borders are under very heavy pressure. Will this create security problems for national territories and across national boundaries? We are therefore concerned about how to define and redefine security within these terms.*

The United Nations' Brown says developed nations like the United States must help head off environmental catastrophes that create ecological refugees. ■ ***May 1987***

■ Where Hunger Strikes

There's good news and bad news in the battle against world hunger.

Harvests around the world are expected to be bigger this year than last. The U.S. Department of Agriculture says thanks largely to rains that brought some relief to dozens of drought- and famine-stricken countries in Africa, more food should be available to the world's hungry. That's the good news.

The bad news is that developing countries still will need nine million more tons of food this year than they normally grow and import just to maintain their current levels of consumption. According to the USDA, it would take twice as much additional food to meet the minimum nutritional needs of everyone in those countries. And they are not likely to get it.

Meeting the rising long-term demand for food around the world is a complex problem. Most analysts agree that there is no overall shortage of food in the world but that its distribution is very uneven. While countries like the United States have large surpluses, others don't have nearly enough.

Overall, world food production has more than doubled since 1950, and some developing regions have come a long way toward self-sufficiency. Southeast Asia, for instance, has tripled its output. But other areas have not been as fortunate. Most of Africa has managed only modest gains in food production, and those have been outstripped by the continent's rapidly growing population. Today Africa produces less food per person than it once did, and more people go hungry.

There are no easy answers to the problem. Advances in agriculture offer hope for more growth in food production. But analysts say poverty, civil strife, corruption, population growth and weather are all part of the problem, too. And any of those things can stand in the way of a better life for the world's hungry. ■ ***April 1986***

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■ Teacher's Guide

Greg Anderson

Concept Mapping with Earthwatching III

What is Concept Mapping?

Concept mapping is a technique for drawing a kind of visual road map of how concepts are connected and understood. By drawing a concept map of an "Earthwatch" script, for example, you can identify the key concepts and show the relationships between them, helping your students understand more clearly the meaning of the script.

"Concept" means a regularity in an object or event that is labeled with a word, like "bottles," "air," "recycling," and "pollution." A concept is given new meaning when it is linked with other concepts, as in "recycling the bottles" or "pollution in the air." Concepts also change when new connections are made. Consider this sequence using the concept "grass": "grass is green," "grass is a plant," "grass is a monocot," "grass photosynthesizes." With each phrase, the meaning of the concept "grass" becomes broader and richer.

Concept mapping can foster more creative, meaningful, long-term learning as well as more positive feelings about learning. Students from grade 1 on have been taught how to use concept mapping to help them learn more effectively. By drawing concept maps, students begin to see the relationships between new information and what they already know. The new information then becomes more relevant to them and can be recalled more readily. In addition, in mapping even old and familiar material, students sometimes recognize new relationships and meanings.

By examining your students' concept maps with them, you can learn what they know and think about a subject. (Are they misunderstanding an idea or missing a concept? Do they feel confused or frustrated? Or do they understand the topic with great insight in a way you never expected or even thought of yourself?) You can then tailor the lesson to fit their needs. Thus, concept maps help us take into account the most important factor influencing learning—what students already know—and then teach them accordingly. Also, by comparing maps that students draw *before* a lesson with those they draw *after* it, you can assess how well a student understands what you taught.

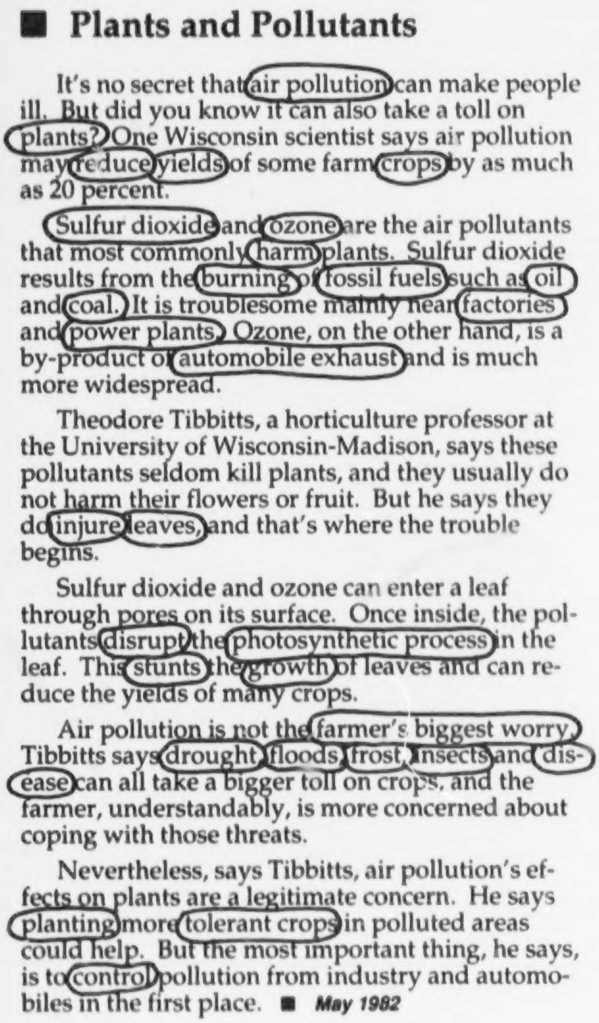
For a comprehensive discussion of concept mapping and its uses, see Novak and Gowin (1984, pp. 15-54).

How to Draw a Concept Map

"Earthwatch" scripts are excellent materials for concept mapping because they offer short, concise descriptions of important subjects or issues.

Step 1: Select and read an Earthwatch script. Circle the key concepts necessary for understanding the script (Figure 1).

Step 2: Decide which concept is the most important or most inclusive idea, an[illegible] make a list with this concept at the top. Find the next most general concept in the script and write it next. Continue to rank-order all the concepts. There is no single "correct" way to rank the concepts because the meaning of the text may be interpreted in more than one way (Figure 2).



Plants and Pollutants

It's no secret that air pollution can make people ill. But did you know it can also take a toll on plants? One Wisconsin scientist says air pollution may reduce yields of some farm crops by as much as 20 percent.

Sulfur dioxide and ozone are the air pollutants that most commonly harm plants. Sulfur dioxide results from the burning of fossil fuels such as oil and coal. It is troublesome mainly near factories and power plants. Ozone, on the other hand, is a by-product of automobile exhaust and is much more widespread.

Theodore Tibbitts, a horticulture professor at the University of Wisconsin-Madison, says these pollutants seldom kill plants, and they usually do not harm their flowers or fruit. But he says they do injure leaves, and that's where the trouble begins.

Sulfur dioxide and ozone can enter a leaf through pores on its surface. Once inside, the pollutants disrupt the photosynthetic process in the leaf. This stunts the growth of leaves and can reduce the yields of many crops.

Air pollution is not the farmer's biggest worry, Tibbitts says drought, floods, frost, insects and disease can all take a bigger toll on crops, and the farmer, understandably, is more concerned about coping with those threats.

Nevertheless, says Tibbitts, air pollution's effects on plants are a legitimate concern. He says planting more tolerant crops in polluted areas could help. But the most important thing, he says, is to control pollution from industry and automobiles in the first place. ■ *May 1982*

Figure 1: Key Concepts in "Plants and Pollutants"

air pollution
sulfur dioxide/ozone
burning
fossil fuels
automobile exhaust
oil/coal
factories/power plants
plants
reduce
crop yields
disrupt
photosynthetic process
injure/stunt
growth
leaves
farmer's biggest worry
drought/floods/frost/insects/disease
control (of pollution)
planting
tolerant crops

Figure 2: Concepts in "Plants and Pollutants" in Declining Order of Importance

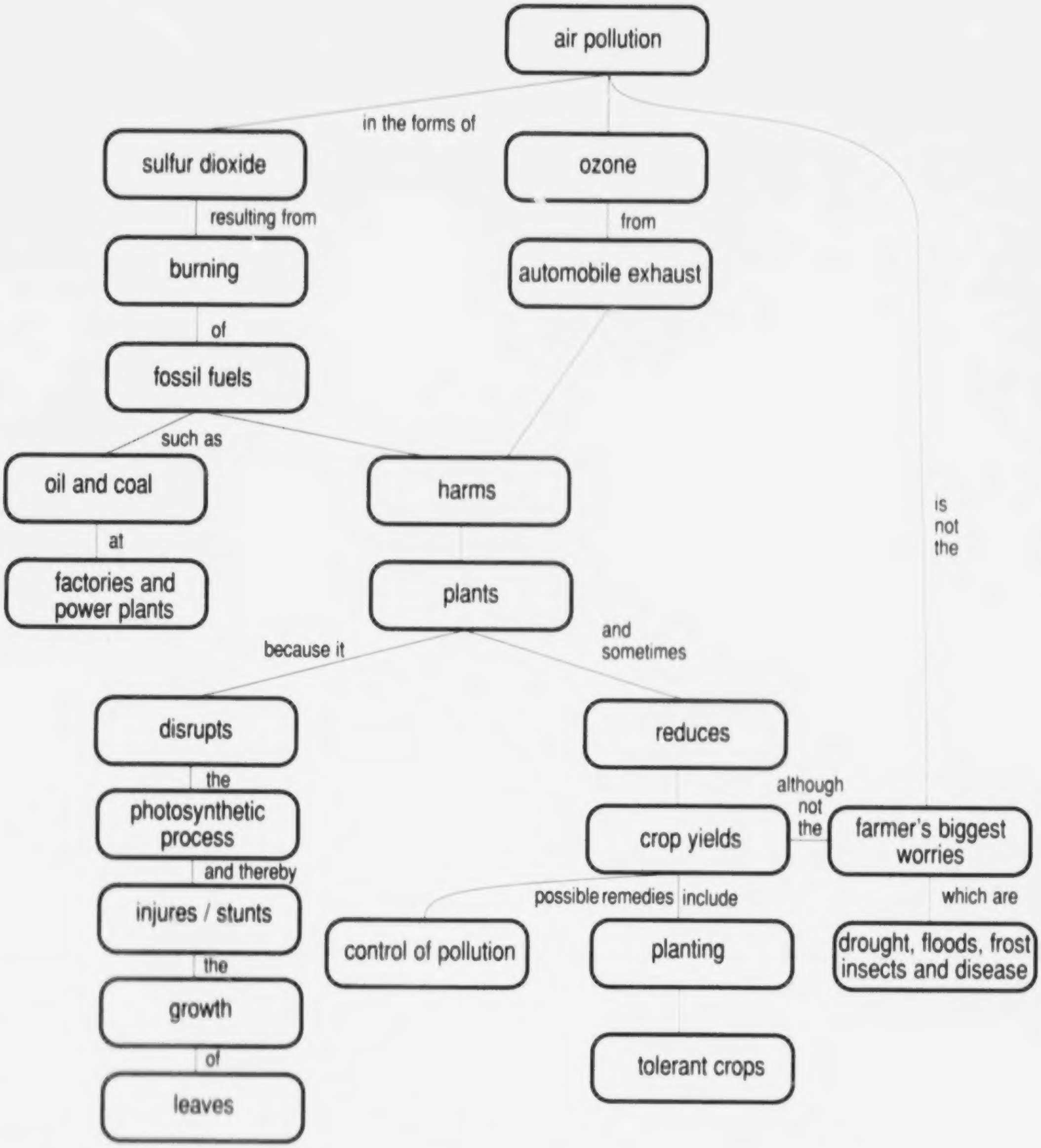

air pollution
in the forms of
sulfur dioxide
ozone
resulting from
burning
from
automobile exhaust
of
fossil fuels
such as
oil and coal
harms
at
factories and power plants
plants
is not the
because it
and sometimes
disrupts
reduces
the
photosynthetic process
although not the
crop yields
farmer's biggest worries
and thereby
injures / stunts
possible remedies include
which are
the
control of pollution
planting
drought, floods, frost insects and disease
growth
of
tolerant crops
leaves

Figure 3: A Concept Map of "Plants and Pollutants"

Step 3: Begin constructing a concept map by placing the broadest, most inclusive concept at the top of a large piece of paper. Work down, adding more specific concepts.

Step 4: Join the concepts with lines and label the lines with linking words that show meaningful connections between the concepts. One way to practice mapmaking is to write concepts and linking words on paper rectangles and then rearrange these as you see new relationships.

Step 5: Now look for links between concepts and label these connections. You can add concepts not in the text to increase the comprehensiveness of the map or to clarify your understanding of the concepts. You also can add examples of concepts (e.g., soybeans, potatoes, tobacco, grapes, and peas are examples of the concept "crop") (Figure 3).

Step 6: Remember that there is no one way to draw a concept map. As your understanding of relationships among concepts changes, so will your map. Draw a new map if you see new ways to link concepts. Keep your maps and refer to them to help you see how your understanding evolves.

Now that you and your students have drawn (and redrawn) concept maps of a script, have one of the map-makers "read" the map so that it's clear to the other students what the script is about. Are there any concepts you would like to add to help you understand the script more completely? Do you have questions about the content that you'd like to investigate? (Example questions for the script mapped in figures 1-3 are presented in the following section, Questions for Classroom Investigation.) Come up with your own questions for the script you mapped, then find the answers to some of them. Remember that concept mapping can be used to clarify any subject.

Scoring Criteria

Novak and Gowin (1984, p. 36) suggest using the following scoring system to evaluate how well your students have integrated and understood this exercise (Figure 4).

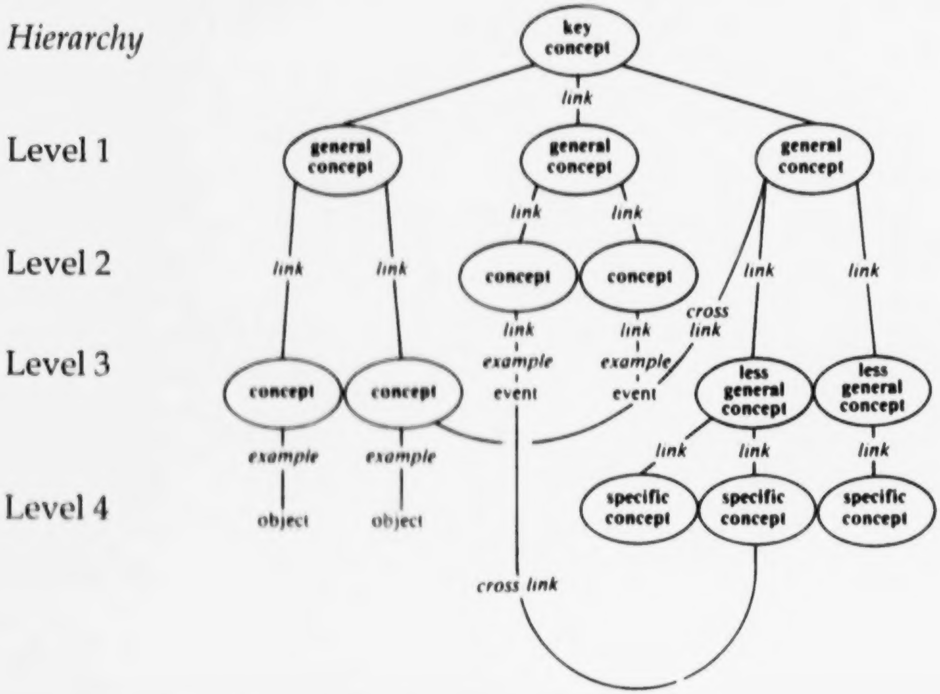
Propositions Is the relationship between two concepts indicated by the connecting line and linking word(s)? Is the relationship valid? For each meaningful, valid proposition shown, score 1 point.

Hierarchy Does the map show hierarchy? Is each subordinate concept more specific and less general than the concept drawn above it (in the context of the material being mapped)? Score 5 points for each valid level of the hierarchy.

Cross links Does the map show meaningful connections between one segment of the concept hierarchy and another segment? Are the relationships shown significant and valid? Score 10 points for each cross link that is both valid and significant, 2 points for each cross link that is valid but does not illustrate a synthesis between sets of related concepts. Cross links can indicate creative ability; therefore, special care should be taken in identifying and rewarding its expression. Unique or creative cross links might receive special recognition or extra points.

Examples Specific events or objects that are valid examples of those designated by the concept label can be scored 1 point each.

Criterion (optional) In addition, a criterion concept map can be constructed and scored for the material to be mapped, and the student scores divided by the criterion map score to give a percentage for comparison. (Some students may do better than the criterion and receive more than 100% on this basis.)


Hierarchy
key concept
link
Level 1
general concept
general concept
general concept
link
link
Level 2
link
link
concept
concept
link
link
cross link
Level 3
link
link
example
example
concept
concept
event
event
less general concept
less general concept
example
example
link
link
link
Level 4
object
object
specific concept
specific concept
specific concept
cross link

Scoring for this model:

Relationships (if valid)	=	14
Hierarchy (if valid) 4 x 5	=	20
Cross Links (if valid and significant) 10 x 2	=	20
Examples (if valid) 4 x 1	=	4
		58 points total

Figure 4: Scoring Model for Concept Maps

Questions for Classroom Investigation

Although each script in *Earthwatching III* presents facts and issues on a topic, a script may leave some questions unanswered and may stimulate other questions worth investigating. *Earthwatching III* can suggest investigations not only in science but in art, history, literature, geography, social studies, mathematics and other disciplines. We encourage you and your students to ask further questions about the topics discussed in this book and find imaginative ways to incorporate them into your studies.

To get you started, here are some examples of spinoff questions from several scripts. Each question could serve as a subject for classroom investigation.

"Plants and Pollutants"

Page 6

- What is combustion? What are the results of this process?
- How do we develop pollution-tolerant plants?
- How can sulfur dioxide and ozone pollution affect people?
- Why is sulfur dioxide pollution less pervasive than ozone pollution? Is sulfur dioxide pollution a problem only near factories?
- Why is ozone called a "by-product" of car exhaust? How does it form? What is the chemical formula for ozone? Why is ozone so reactive?
- What is the structure of a leaf? How does ozone enter a leaf? What does ozone do to a leaf? How does this affect the plant?
- Should farmers be more concerned about ozone pollution than they are? Should other people be more concerned, too? Why?
- How do we measure ozone levels? How would you find out about ozone levels in your state? In the United States?
- Where is ozone monitored in your state? In the United States?
- Are the causes and effects of the ozone problem discussed in the script the same as or different from those of the ozone layer in the upper atmosphere?
- What are some other forms of air pollution?
- How can we control air pollution?
- What can you do to reduce ozone and other forms of air pollution?

"The Snowflake Man"

Page 108

- How do snowflakes form? Why do they have six sides?
- Do people still study snowflakes? Where and why (e.g., in avalanche control, military research, oil rigs, glaciers, the Antarctic, art and design)?
- What effect does snow have on the landscape, on wildlife, on people (e.g., insulation, shelter, mobility, food availability)?
- In our society, what are peoples' attitudes towards snow? Is snow considered beautiful, a nuisance? What attitudes about snow are portrayed on television weather forecasts? Why do we often have a negative view of snow? Do you like snow? Why or why not? What are some other societies' attitudes about snow (e.g., the Laplanders and Inuit peoples of the Arctic)?
- How is snowfall recorded? Is there as much snowfall in your state now as there used to be?
- Have weather patterns changed since Snowflake Bentley's time?
- Obtain annual snowfall records for your region and draw a graph. If you see long-term changes in snowfall, what do you think are some possible reasons for the changes?

"Big Blasts and Bumper Crops"

Page 3

- What are volcanoes? How do they form? Where do they form?
- What role do volcanoes play in the Earth's evolution?
- Why do you think paintings of dinosaurs usually have volcanoes in the background? Is this an accurate portrayal of the Earth when the dinosaurs were living?
- Although a volcanic explosion on the equator may benefit U.S. corn crops, what are the effects of the explosion where it happens (e.g., El Chichon in Colombia, Mount St. Helens in Washington)?
- What other ways can volcanic activity be beneficial or harmful to people (e.g., geothermal energy in Iceland and New Zealand, poisonous gas in Cameroon)?
- What are some historic "big bangs" (e.g., Krakatoa, Vesuvius)? What eventually happened to the ash that was spewed into the upper atmosphere by these eruptions?
- If ash from volcanic eruptions affects the world's weather, what do you think dust and smoke from a nuclear explosion could do?
- Describe what is meant by the concept "spaceship Earth" or the phrase "everything is connected to everything else."
- What are some folk stories/fears/myths about volcanoes?
- How well can scientists predict when volcanoes will erupt? How do they do this?

Example Activity

Earthwatching III can be useful in many curriculum areas. The following activity shows how the script, "Dumping Diapers," could be used in a math unit to illustrate concepts of measurement. It also suggests how to use the same script and subject to teach lessons in home economics and to help students make the connection between classroom activities and the world outside of school. We encourage you to devise similar activities from the many other scripts in this book.

Activity

Objective: To help students develop skills in measurement and cost analysis and interpret their findings in the context of an actual environmental problem.

Grades: 7-12.

Subjects: Mathematics, social studies, home economics, health, environmental education.

Background: *Earthwatching III* script "Dumping Diapers" (page 85).

Materials: Disposable diapers, metric ruler, gram balance, graduated cylinder, container for saturated diaper, water.

Procedure

Step 1. Measure a dry disposable diaper as follows:

a. Use the gram balance to calculate weight (to the nearest gram).

b. Use the metric ruler to calculate volume in cubic centimeters.

Step 2. Measure a saturated disposable diaper as follows:

a. Use the graduated cylinder to calculate maximum volume of water a disposable diaper can hold (to the nearest milliliter).

b. Use the balance to calculate (1) the weight of the saturated diaper and (2) the weight of the water alone.

c. Use the ruler to measure the diaper's volume (to the nearest cubic centimeter).

Step 3. Answer the following questions:

a. Assume that the maximum weight limit for a typical garbage can is 18.5 kilograms. How many saturated diapers can it hold?

b. Read the *Earthwatching III* script "Dumping Diapers." How many days will it take a family with one young child to accumulate 18.5 kilograms of saturated disposable diapers (round to the nearest 0.25 day)?

c. If garbage collection is once a week, how many garbage cans will a family that uses disposable diapers need for two young children?

d. If a garbage truck can carry an average of 5,900 kilograms of refuse, how many garbage cans full of saturated disposable diapers can one truck haul without exceeding its capacity?

e. One garbage truck can hold a week's worth of saturated disposable diapers from how many children in all?

f. Calculate the volume of a typical one-car garage in cubic meters. If the garbage collector goes on strike and a family with one young child has to store its saturated disposable diapers in the garage, how long will it be before the garage is full?

g. Calculate the total number of diapers a child will need from birth to age two. Calculate the mass and volume of both dry and saturated disposable diapers used by the child during this time.

Once your students have done the measurements and mathematical calculations, you can either consider the lesson complete or discuss the real-life implications of the measurements they derived. Here are some questions raised by the "Dumping Diapers" activity that you may wish to consider with your students.

- What happens to disposable diapers after people throw them away?
- About how many children in your community are under the age of two? If all of them used disposable diapers, how much landfill space would be filled with diapers in one year? Do you think this is a good way to use land? Why or why not?
- How many years will it be before your community landfill is full? What will your community do with its waste after that?
- What laws does your community have for treating human waste? Do these laws apply to waste contained in disposable diapers?
- Assume that your local store sells disposable diapers in two sizes of bags: 48 per bag for $10.99 and 18 per bag for $4.49. What would a sales tax of 5 percent add to the cost of each bag? Which is your best buy? Calculate the percentage of your savings.
- The smaller bag has a rebate coupon: If you mail in labels from three small bags, you'll get a $1 rebate. Considering the rebate, which is your best buy (including the 5 percent tax)? Calculate the percentage of your savings.

- Assume that a child requires 48 cloth diapers, which can be washed and reused, from birth to age two. A package of 12 cloth diapers costs $8.37. What is the total cost to purchase cloth diapers for one child, including a 5 percent sales tax? What is the cost difference between a two-year supply of disposable diapers and a two-year supply of cloth diapers?
- What other costs should parents consider when using cloth diapers (e.g., detergent, electricity, water, washer and dryer wear, time)?
- A commercial diaper service has compiled the following statistics about diaper costs (toddlers often require 90 or more diapers per week):
  90 diapers, home delivery service: $10.15/week
  90 disposable diapers: $18.50/week
  90 diapers, home-laundered: $9.36/week
  (including estimated costs of detergent, water, electricity, washer and dryer, etc.)

  If you were a parent, which diaper option would you choose? Why? Is cost your only concern? Have you considered other pros and cons, such as energy use, environmental impacts, convenience, your child's comfort, etc.?

More Questions & Activities

- About 80 million children are born in the world every year. If all of them used disposable diapers, how many disposables would be consumed every year? What do you think about this?
- Investigate what people in other parts of the world use to diaper their children.
- Brainstorm ways that old cloth diapers can be recycled—used for other purposes.
- Investigate how much paper pulp is required to manufacture a disposable diaper. How many trees must be cut to make the diapers used by one child from birth to age two?
- Investigate the possible health effects of disposing of human wastes in landfills.

Infusing Earthwatching III into a Curriculum

At first glance, "infusion" may sound complicated, but it is really a simple idea. It's also an important one. Infusion means using environmental topics like those in *Earthwatching III* as a vehicle to achieve your teaching objectives in math, art, languages—in all subjects (not only science) at all grade levels. By doing this, you integrate environmental education into the regular curriculum rather than treat it as a separate subject.

Adding environmental content to the curriculum may require additional planning and instruction. The exact amount depends on how much information you have at hand and how much more you would like to know about a topic. But you do *not* have to be an expert on the environment to use environmental topics in your classes. By selecting examples of personal interest to you and your students and investigating them together, everyone can learn more. Such inquiry can enhance your teaching and your students' enthusiasm about learning.

The following paragraphs describe some environmental topics or activities that can be addressed in various curriculum areas according to *A Guide to Curriculum Planning in Environmental Education* (Engleson 1985, pp. 60-62).

Agriculture

Groundwater contamination from agricultural chemicals; organic and inorganic pest controls; soil erosion, nutrients, and conservation; water conservation, irrigation, salinity, and nonpoint-source pollution; threatened and endangered species and habitats; energy issues; biotechnology and its impact on agriculture; economics and environment.

Art

The nature of aesthetics; environmental ethics; natural and urban environmental aesthetics; aesthetics in land-use planning; the role of art in communicating environmental messages; architecture; historic preservation.

Foreign Language

Global perspectives; how we perceive people of other countries; how people of other countries view us; commonalities and differences among peoples; how people of other countries feel about and deal with environmental issues; how we influence the environments of other nations. (Study current publications to learn about other nations' environmental concerns, such as France's position on nuclear energy, the effects of acid rain on German forests, and the destruction of tropical rain forests in Latin America.)

Health Education

The relationships among physical, mental, and environmental health; occupational health; consumer health; hazardous chemicals in the home and workplace; the role of government in health issues; air, water, and noise pollution; healthful recreation; nutrition; disease; population issues.

Home Economics

Water and energy use and conservation; excess packaging and solid waste disposal; recycling; food additives; hazardous household chemicals.

Industrial Education

Resource use and conservation (energy, raw materials, water, land, air, etc.); use and disposal of hazardous chemicals; aesthetics in structural design; social and environmental responsibility; creativity; alternative technologies.

Language Arts	Use environmental subjects in creative writing; reading; dramatics; speech; journal, editorial, letter, article, script, and report writing; research; literature; literary analysis.
Mathematics	Use environmental subjects when collecting and analyzing data; communicating results through charts and graphs; studying geometric shapes and patterns.
Physical Education	Canoeing, backpacking, camping, fishing, hiking, skiing, swimming, etc.; outdoor ethics; safety; pros and cons of hunting; consumptive versus nonconsumptive outdoor activities; relationship of environment to human physical and mental health.
Science	Develop problem-solving skills and understand relationships among science, technology and society.
Social Studies	Describe, study, and analyze the relationships of human actions and behaviors to the environment and their impacts on the environment; develop citizenship skills, geography concepts, map skills; consider possible futures.

The next two sections describe in greater detail how to use *Earthwatching III* in social studies and health education, two curriculum areas for which it is especially suited.

Using Earthwatching III in Social Studies

The following chart correlates scripts in *Earthwatching III* with content that the Wisconsin Department of Public Instruction suggests be covered in K-12 social studies education. It is based on chapter 2 of *A Guide to Curriculum Planning in Social Studies* (Hartoonian 1986).

The chart is by no means all-inclusive; it merely provides examples of where *Earthwatching III* scripts might be used in the social studies curriculum. We encourage you to review the many other scripts in this book that address social issues and develop ways to incorporate their content into your social studies program at all grade levels.

Topic	Grade	Relevant Curriculum Questions	Relevant Scripts/Page Numbers
Air pollution	K	How can you care for your environment?	The Smog's on the Other Flue/7, Poolside Chat/66, Victims of Pollution/81, Homemade Air Pollution/99, and others▼
	5	What are the current trends in resource use? Is it possible to change these trends? How?	
Hunger	K	How do different people meet their needs?	Bad Taste?/94, This Spud's for You/95, Feeling the Strain/110, Tragedy of a Continent/121, Where Hunger Strikes/122, and others▼
	5	How are the United States and the rest of the world interdependent? What are current trends in resource use and population growth? What alternatives exist for changing these trends?	
	6	What issues, crises, and opportunities face each cultural region of the world?	
	7	What are the causes and consequences of an uneven distribution of wealth in the world?	
	8-9	To what degree is population growth a problem? What issues of today are likely to be with us in the future?	
	10-11	How is your community interdependent with the rest of the world?	
Recycling	1	How does your school recycle materials? Your neighborhood? Your community?	New Life for Old Milk Jugs/77, Recycling Simplified/81, Return of the Returnables/83, Recycling at a Ripe Age/84, New Deposit, Big Return/85, Shifting Gears/86, and others▼
	5	What are the current trends in resource use? Is it possible to change these trends? How?	

Topic	Grade	Relevant Curriculum Questions	Relevant Scripts/Page Numbers
	6	What changes have taken place in the way people use resources and produce goods and services?	(Continued from page 141)
	10-11	How did life in the United States change during and after World War II?	
Oceans	2	What are oceans? How many oceans can you find on a globe? What are coastlines? How do coastlines differ from each other? How close do you live to the nearest ocean?	The Fear of Cod/20, Surf and Turf/45, Mussel-bound Oil Rigs/51, Killer Waves/51, Skimming the Surface/53, A Plague of Plastic/86, Underwater Relief/98, and others▼
	3	How do oceans affect weather and climate? How do they affect our lives?	
	4	How do oceans influence coastal communities? In what ways do people make their livings from the oceans?	
	7	How are people and oceans interrelated?	
	9-10	How do people and society affect oceans? Is it possible to harm oceans? How?	
Transportation	2	What forms of transportation are available in your community? Other communities?	A Better Idea/66, Poolside Chat/66, A Saline Solution/78, Travel Expenses/107, and others▼
	11	How might technology influence our future?	
Climate	3	How do geography and climate affect communities?	Big Blasts and Bumper Crops/3, No Previous Experience/3, Behind the Drought/4, The South Rises Again/47, Our Brimming Great Lakes/48, History on the Bottom of the Sea/52, and others▼
	7	What is the nature of relationships between people and Earth systems? How are nations interdependent?	
	9-10	What do people mean when they say the world has become a global community?	

Topic	Grade	Relevant Curriculum Questions	Relevant Scripts Page Numbers
Cities	3	Why do people live in cities? How do cities influence the environment? How does the size of a city influence the way its people live?	Star Light, Star Bright/7, Down the Drain/49, An Island in Distress/50, Thirst Aid/60, Leaky Pipes/61, City Limits/87, Paying the Piper/88, From Boom to Bust/89, Pushing the Limits/115, Thailand's Sinking City/115, Supercity/116, and others▼
	7	What is the natue of relationships beteen people and earth systems? How are nations interdependent?	
	8-9	What important issues do nations face today?	
Farming	3	What special problems do farmers face today? How do farming methods compare in different places?	Plants and Pollutants/6, New Roots/33, Salt of the Earth/35, Preventable Pollution/36, Harvest of Dust/38, Dust to Ashes/68, Chemical Dependence/118, Another Japanese Success/120, and others▼
	6	What changes have taken place in the ways people use resources?	
	8-9	What important issues do nations face today? How are technology and global interdependence changing the economy of our nation and the world?	
	11	How might technology influence our future?	
Great Lakes	2	What are the Great Lakes? Where are the Great Lakes on a globe? How close do you live to the nearest Great Lake? Which states and provinces border the Great Lakes?	The South Rises Again/47, Our Brimming Great Lakes/48, A Costly Diversion/48, Probing a Great Lake's Plumbing/49, Down the Drain/49, Hanging Ten on Lake Michigan/57, and others▼

Topic	Grade	Relevant Curriculum Questions	Relevant Scripts/Page Numbers
	3	How do the Great Lakes affect weather and climate in the region around them? What cities are located on the Great Lakes? Why were these cities built on the lakes?	(Continued from page 143)
	5-6	Who were the first people to live near the Great Lakes? Which early European explorers visited the Great Lakes? How was settlement of your state or province influenced by the Great Lakes? How and when did the Great Lakes get their names?	
	6	What role do the Great Lakes play in international trade?	
	7	How and why do the United States and Canada share the Great Lakes?	
	8	What do the Great Lakes states and provinces have in common with other states and provinces? How are they different?	
	9-10	Where do the water and pollution in the Great Lakes come from? Which lakes are cleanest? Which are most polluted? How can lake pollution be prevented?	
Political boundaries	4	What states or provinces are your neighbors? How do maps tell us special stories about our region?	Acid Revelations/8, Surf and Turf/45, The South Rises Again/47, A Costly Diversion/48, Agreeable States/83, Feeling the Strain/110, Antarctic Disharmony/117, and others▼
	7	How can conflicts between states and nations be resolved or avoided?	
Nature and beauty	4	How do people enjoy nature's gifts?	Forest Lawns/41, The Snowflake Man/108, A Parks Pioneer/108, and others
Resources and conflict	5	Why did the colonists seek independence from European nations?	The Tree that Started a War/28, Grim Harvest/116, Aftermath of War/117, Antarctic Disharmony/117, and others▼

Topic	Grade	Relevant Curriculum Questions	Relevant Scripts/Page Numbers
	7	How is the future of the United States tied to the future of the world? What are the causes and consequences of uneven distribution of wealth and resources in the world?	
	9-10	How did imperialism and colonialism contribute to exploitation, tensions, and confrontations that led to international conflict?	
	10-11	What were the major causes of the American Revolution? How do geography, land settlement, cultural conflict, and history interrelate?	
	11	How do other cultures view our culture? What have been the results of international conflict? What are the challenges to peace today?	
Population	8-9	Is population growth a problem? Why? How serious a problem is it?	Feeling the Strain/110, A Matter of Proportions/110, Crisis? What Crisis?/111, Pushing the Limits/115, Where Hunger Strikes/122, and others▼
	9-10	How has geography influenced population in Asia?	
Government and regulation	8-9	How are political decisions made? How can citizens participate in and influence politics?	Victims of Pollution/81, Burden or Blessing?/82, Towards Greater Safety/82, Return of the Returnables/83, Ski Control/87, and others
Energy	5	What are the major natural resources?	Bright Ideas/65, Window Breakthrough/65, Looks Good on Paper/67, Cold Facts for the Hot Tropics/68, Dust to Ashes/68, Quest for Fuel/69, Hawkeye Hydro/70, Carrying the Fire/70, and others▼
	6	What changes have taken place in the ways people use resources?	

Topic	Grade	Relevant Curriculum Questions	Relevant Scripts/Page Numbers
	7	What are the causes and consequences of the ways people use resources in the world?	(Continued from page 145)
Hazardous waste	3	How do communities try to solve their problems?	Hidden Polluters/50, Not-So-Clean Industry/73, Punchless PCBs/74, Household Hazards/74, Costly to the End/75, From Here to Eternity/75, The Wrong Target/98, and others▼
	4	What could happen to the natural resources of your state or province if they were used wisely or unwisely? What is being done to protect them?	
	5	What major environmental issues do we face today? What are some possible solutions?	
Water pollution	K	How can you care for your environment?	Skimming the Surface/53, Scales of Justice/54, Tourists and Toxins/54, Lake Woes, Begone!/55, Turnaround at Tahoe/88, and others▼
	5	What are the current trends in resource use? Is it possible to change these trends? How?	
Global environment	1	What is a globe? What can it tell us?	Big Blasts and Bumper Crops/3, Protecting "Our" Birds/14, Competition from Abroad/16, Not a Drop to Drink/61, Grim Harvest/116, and others▼
	9-10	What do people mean when they speak of a world community?	
	10-11	What global issues does the United States face? How are political and other institutions responding to those issues? How is your community an example of global interdependence?	

Topic	Grade	Relevant Curriculum Questions	Relevant Scripts/Page Numbers
The future	7	How is the future of the United States tied to the future of the world?	This Land is Your Land/40, Locked Out/42, From Here to Eternity/75, Feeling the Strain/110, A Matter of Proportions/110, Crisis? What Crisis?/111, and others▼
	8	What challenges is the U.S. likely to face in the future?	
	8-9	What are some important issues we face today? How will technology and increasing global interdependence change the economies of our nation and world?	
	9-10	What will our planet be like in the future?	
	11	How do other cultures view our culture? How has technology changed the way Americans relate to each other and to the land?	

Using Earthwatching III in Health Education

The following chart correlates scripts in *Earthwatching III* with content that the Wisconsin Department of Public Instruction suggests be covered in K-12 health education. It is based on Table 1 in *A Guide to Curriculum Planning in Health Education* (Bradley 1985).

The chart is by no means all-inclusive; it merely provides examples of where *Earthwatching III* scripts might be used in the health instruction curriculum. We encourage you to review the many other scripts in this book that address human health issues and develop ways to incorporate their content into your health program at all grade levels.

Topic	Grade	Appropriate Content Areas	Relevant Scripts/Page Numbers
Pesticides and health	K	Accident prevention and safety	Nature's Pesticides/23, Ocean Spray/34, Chemical Controversy/35, The Wrong Target/98, Chemical Dependence/118, and others
	3-12	Environmental health	
	6-12	Consumer health	
Nutrition in the Third World	1-12	Nutrition	Waiter, There's No Fly in My Soup/93, Bad Taste/94, Tragedy of a Continent/121, Where Hunger Strikes/122, and others
Sources of food	1	Nutrition	Fish Fat Facts/93, Waiter, There's No Fly in My Soup/93, Chemistry, Flavors, and Fillets/95, This Spud's for You/95, and others
Recycling	3-6	Environmental health	New Life for Old Milk Jugs/77, Recycling Simplified/81, Return of the Returnables/83, Recycling at a Ripe Age/84, New Deposit, Big Return/85, Shifting Gears/86, and others
Air pollution and health	3-12	Environmental health	Victims of Pollution/81, The Smell of Success/97, Homemade Air Pollution/99, Smoke Alarm/100, and others
Hunger	3-12	Nutrition	Waiter, There's No Fly in My Soup/93, This Spud's for You/95, Tragedy of a Continent/121, Where Hunger Strikes/122, and others
Water pollution and health	3-12	Environmental health	Leaky Pipes/61, Victims of Pollution/81, Gut Reaction/101, and others
Recreation	4-12	Environmental health	Teach Your Children/56, Handicapped on the High Seas/57, Hanging Ten on Lake Michigan/57, The Big Chill/101, A Parks Pioneer/108, and others

Topic	*Grade*	*Appropriate Content Areas*	*Relevant Scripts/Page Numbers*
Occupational health and safety	4-12	Community health, consumer health	Not-So-Clean Industry/73, Victims of Pollution/81, Towards Greater Safety/82, Perilous Panic/96, Dangers of Development/121, and others
Disease	5-12	Prevention and control of disease	Get the Lead Out/97, Homemade Air Pollution/99, Catching Ultraviolet Rays/99, Smoke Alarm/100, Gut Reaction/101, and others
Hazardous waste	10-12	Environmental health	Hidden Polluters/50, Not-So-Clean Industry/73, Punchless PCBs/74, Household Hazards/74, Costly to the End/75, From Here to Eternity/75, The Wrong Target/98, and others
Population	10-12	Family life, environmental health	Feeling the Strain/110, A Matter of Proportions/110, Crisis? What Crisis?/111, Pushing the Limits/115, Where Hunger Strikes/122, and others

Sources of Additional Information

Thousands of public and private organizations throughout the United States and Canada offer a variety of materials—books and pamphlets, films and videotapes, computer software, and curricula—helpful to environmental educators.

One of the most comprehensive lists and descriptions of these organizations is the *Conservation Directory* published annually by the National Wildlife Federation, 1400 Sixteenth Street N.W., Washington, DC 20036-2266. (Cost of 1990 edition: $18 plus $3.50 shipping and, in certain states, sales tax). Among other things, this excellent directory lists sources of information and audio-visual materials on conservation and environmental topics, current state education agency coordinators for environmental education, and other useful directories.

In addition to *Earthwatching III*, the Sea Grant Institute and the Institute for Environmental Studies at the University of Wisconsin-Madison offer many publications, including a selection of educational materials, on the Great Lakes and other environmental topics. For lists and prices, contact the UW Sea Grant Institute, 1800 University Avenue, Madison, WI 53705 (phone 608/263-3259), and the Institute for Environmental Studies, Room 15 Science Hall, 550 N. Park Street, Madison, WI 53706 (phone 608/263-3064).

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Index

A

Agriculture
  Biotechnology 111
  Chemical use 35, 118
  Climate effects 3, 116
  Conservation practices 36-37
  Crops 33, 95
  Effects of air pollution 6
  Energy from grain dust 68
  Energy use 67
  Foreign 38, 118, 120-122
  Irrigation 59, 61
  Near urban areas 87
  Pests and pesticides 23, 33-34
  Salt on cropland 35
Air Pollution
  Acid rain 8, 53, 55
  Chlorofluorocarbons (CFCs) 8
  Effects on agriculture 6
  Effects on astronomy 7
  Foul odors 80
  From wood-burning stoves 7
  Historical 73
  Indoor 99-100
  Near parks and preserves 6

B

Birds
  Dusky seaside sparrow 14
  Migration 13-15
  Refuges 17
  Threats to Florida seabirds 15

C

Cities
  Air quality 80
  Housing 89
  Parks 108
  Urban planning 87-89
  Urban problems 115-116
  Waste disposal 81
  Water use 49, 60-61
Climate
  Disruptions 3, 116
  Drought 4, 121-122
  Effect on Great Lakes 48
  Evolution of Earth's climate 52
  Global warming 3
Coasts
  Coastal oceans 45
  Development 39
  Ecology 53, 59
  Gulf of Mexico wetlands 37
  Severe weather 51
  Wildlife 15, 26
Conflict
  American Revolution 28
  Ethiopia 112
  Genetic engineering 35
  Nuclear war 116
  Over Antarctica 117
  Over global resources 110
  Over natural resources 110, 122
  Over wilderness preservation 40
  Vietnam 117
Conservation
  Foreign 109, 117
  In Florida Everglades 41
  In New Jersey 40
  Prairie plant communities 38
  Wilderness preservation 42

D

Development
  Housing 89
  Industrial 120
  Land use regulations 88
  Near parks and preserves 6, 40-41, 87

  Third World 105, 115-121
  Urban 36, 87-89
  Worldwide 111

E

Ecosystems
  Aquatic 18-19, 53, 58
  California chaparral 29
  Forest 18
  Gulf Coast 37
  Marine 46
  Prairie 38
Endangered Species
  Captive breeding 11, 16
  Clams and mussels 19
  Extinction 14
  Gorillas 27
  Habitat loss 14
  Manatees 26
  Poaching 12
  Threats to Florida seabirds 15
Energy
  From grain dust 68
  From oceans 68
  Hydroelectric 70
  Nuclear 69-70, 75
  Oil 69
  Solar 77
  Wood-burning stoves 7
Energy Conservation
  Automobiles 66
  In industry 67
  Lighting 65
  On farms 67
  Ride sharing 66
  Windows 65

F

Fish/Fisheries
  Commercial fishing 45-47
  Effects of plastic waste 86
  Effects of pollution 54-55
  Exotic species 18-19
  Fish consumption 93, 95
  Great Lakes 83
  Hatcheries 20
  Sharks 20
  Sport fishing 45, 55, 76
Food
  Fish 93, 95
  Insects 93
  Krill 46
  Potatoes 95
  Shortages 116, 121-122
  Waste in the United States 94
Forests
  Amazon River basin 118
  Autumn foliage 28
  Forest fires 29
  National Register of Big Trees 29
  New England 28
  Protection in India 109

G

Great Lakes
  Exotic species 18-19
  Governors' agreement 83
  Groundwater near Lake Michigan 49
  Maritime history 56
  Plastic waste 86
  Severe storms 5
  Sport fishing 45
  Surface layer 53
  Surfing 57
  Water diversions 48
  Water levels 48
  Water quality 47, 49, 54
  Water sports for the disabled 57
Groundwater
  Near Lake Michigan 49
  Pollution from storage tanks 50
  Protection 50, 60

H

Hazardous Materials
  In households 74
  In microelectronics industry 73
  In Niagara River 54

  - In the Great Lakes 83
  - In water 76
  - Pesticides 98
  - Polychlorinated biphenyls (PCBs) 74
  - Radioactive waste 75
  - Toxaphene 47
  - Workplace 82, 121
- Health
  - Diet in Third World 94
  - Effects of sunbathing 99
  - Fish consumption 93, 95
  - Hypothermia 101
  - Insect consumption 93
  - Medicine 96, 98, 111
  - Nature as a cure 42
  - Occupational 82, 96, 118, 121
  - Poisons 98
  - Pollution hazards 81, 83, 97, 99-100
  - Potato consumption 95
  - Sense of smell 97
  - Starvation 121
  - Waterborne diseases (giardiasis) 101
  - Winter depression 100
- History
  - American Revolution 28
  - Christopher Columbus 106
  - Game management 107
  - Maritime 56, 105
  - Native Americans 106
  - Of pollution 73
  - Public parks 108
  - Scientific research 109
  - Snowflake studies 108

I

- Industry
  - Biotechnology 111
  - Energy conservation 67
  - Energy production 69
  - Great Lakes water use 48
  - Nuclear energy 75
  - Occupational health 82
  - Oil 69
  - Pollution 8, 54, 73, 79-82, 120
  - Recycling 85-86
- Insects
  - As human food 93
  - Dragonflies 23
  - Farm pests 34
  - Fire ants 24
  - Garden pests 33
  - Mosquitos 22
  - Natural insecticides 23

L

- Lakes (see also Great Lakes)
  - Effects of acid rain 55
  - Lake Tahoe 88
  - Surface layer 53
- Land Use
  - Agricultural 37-38
  - Amazon River basin 118
  - Effect on groundwater 50
  - In Florida Everglades 41
  - Industrial 6
  - Louisiana wetlands 37
  - On federal land 40, 42
  - Regulations 87-88
  - Residential 39, 41
  - Third World 122
  - Urban 87-89
  - Wildlife refuges 39
- Law and Regulation
  - Antarctic Treaty 117
  - Land use regulations 39, 87-88
  - Law of the Sea 45, 47
  - Occupational health 82
  - Penalties for pollution 54, 81
  - Pollution control 7-8, 50, 80, 82-83
  - Recycling 83
  - Smoking 100

M

- Mammals
  - Bats 25
  - Bears 25
  - Beavers 24
  - Dolphins 13
  - Elephants 12

  - Gorillas 27
  - Killer whales 26
  - Manatees 26

N

- Natural Events
  - Desertification 38, 121
  - Drought 122
  - Floods 58
  - Forest fires 18, 29
  - Hurricanes 39
  - Precipitation 5
  - Seasonal changes 28
  - Severe storms 5
  - Tsunamis 51
  - Volcanic eruptions 3
  - Weather 4
- Natural History
  - Animals and myths 21
  - Asteriod impacts on Earth 52
  - Bat behavior 25
  - Bear behavior 25
  - Bird migrations 13-15
  - Dinosaurs 21
  - Dragonflies 23
  - Earthworms 34
  - Evolution 22
  - Evolution of Earth's climate 52
  - Great Lakes water levels 48
  - Killer whales 26
  - Oldest plant 27
  - Plants 30
  - Shark behavior 20
- Navigation
  - Great Lakes 5, 56
  - Organisms in ballast water 18

O

- Oceans
  - Antarctic Ocean 46
  - Commercial fishing 46, 51
  - Crater in North Atlantic 52
  - Desalination 60
  - Exotic species 18
  - Fisheries 20
  - Law of the Sea 45, 47
  - Marine mammals 11, 13
  - Marine plants 34
  - Maritime history 105
  - Medical products from 98
  - Oil exploration in 69
  - Oil spills 80
  - Plastic waste 86
  - Pollution 53
  - Research 52
  - Surface layer 53
  - Tsunamis 51
  - Water sports for the disabled 57

P

- Parks and Preserves
  - Africa 27
  - Mineral exploration 40, 42
  - National Wildlife Refuge System 39
  - New Jersey pine barrens 40
  - Prairies 38
  - Southwestern United States 6
  - Underwater 56
  - Upper Mississippi River 17
  - Yellowstone National Park 18
- Pests
  - Fire ants 24
  - Genetically engineered pesticides 35
  - Mosquitos 22
  - Natural pesticides 23, 33-34
  - Pesticide use in developing countries 118
  - Sea lampreys in the Great Lakes 19
- Plants
  - Autumn foliage 28
  - Creosote bushes 27
  - Crops 6
  - Distress signals 30
  - Exotic 16
  - Garden 33
  - National Register of Big Trees 29
  - Native plants on residential lawns 41
  - Perennial crops 33
  - Trifoliate orange 30
  - White pine trees 28

Pollution
  Agricultural chemicals 118
  Effect on economics 82
  From disposable diapers 85
  Great Lakes 83
  Health effects 97
  In Japan 81
  In manufacturing 79
  In Poland 120
  In space 84
  In Third World 121
Population
  Growth problems 110-111, 115-116

R

Recreation
  Boating 56
  Camping 101
  Diving 56, 96
  Skiing 87
  Sport fishing 15, 54-55
  Sunbathing 99
  Surfing 57
  Urban 108
  Water sports for the disabled 57
Recycling
  Aluminum cans 85
  Community efforts 81, 84
  Composting 78
  Groundwater 60
  Industrial 86
  Plastic 77
  Returnable bottles 83
Research
  Animal communication 13
  Animal intelligence 12
  Antarctic 117
  Anthropology 105
  Astronomy 7
  By historical figures 108-109
  Composting 76, 78
  Cryptozoology 21
  Diving physiology 96
  Energy conservation 66
  Entomology 22
  Evolution 22
  Fish behavior 20
  Medical 96, 98
  Meteorology 3, 5, 8, 52
  Natural pesticides 34
  Nuclear fusion 70
  Paleontology 21
  Plants 38
  Pollution cleanup techniques 80
  Preservation of species 14
  Psychology 42
  Sea lamprey eradication 19
  Solid waste in landfills 94
  Toxic waste disposal 74
  Water chemistry 53, 55
  Wildlife ecology 107
Rivers
  Delaware 59
  Hydroelectric power 70
  Kickapoo 58
  Mississippi 15, 17, 19, 58
  Niagara 54

S

Soil Conservation
  Alternative farm crops 33
  Benefits 37, 58
  Desertification 38
  Earthworms and soil condition 34
  Erosion at construction sites 36
  Help from beavers 24
Solid Waste
  Composting 76, 78
  Historical problems 73
  Plastic pollution in water 86
  Recycling 77, 81, 84-86
  Returnable bottles 83
  Wasted food 94

T

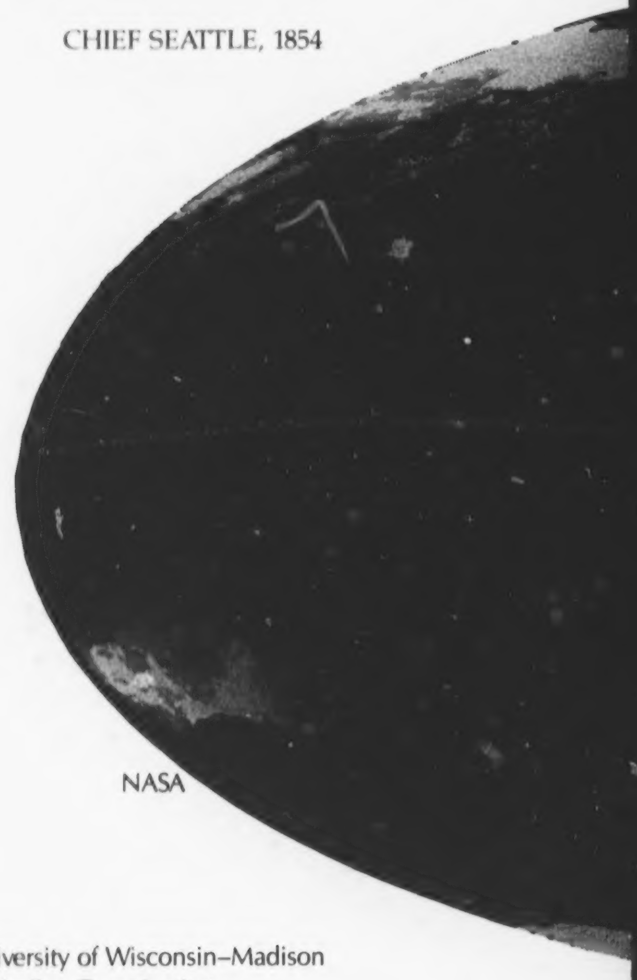
Technology
  Agricultural 59
  Energy production 68, 70
  Energy-saving 65-67

  Genetic engineering 35, 111-112
  Nuclear energy 69-70, 75
  Pollution cleanup and control 79-80
  Problems with high-tech industries 73
  Recycling 77
  Solar energy 77
  Space 84
  Toxic waste disposal 74
Third World
  Aboriginal tribes 105
  Agriculture 118, 122
  Development 119-120
  Ecological refugees 122
  Environmental conservation 109, 112, 117-118
  Famine in Africa 4, 121
  Housing 119
  Nutrition 93-94
  Occupational health 121
  Population problems 38, 110, 115-116
Transportation
  Automobile 66
  Mass transit 107
  Ride sharing 66
  Water pollution from road salt 78

W

Water
  Drinking water 60, 101
  Economic value 48
  Irrigation 35
Water Conservation
  In El Paso, Texas 60
  In Israel 59
  Worldwide 61
Water Pollution
  Acid rain 8, 53, 55
  At Niagara Falls 54
  Citizen watchdogs 59
  Cleanup techniques 80
  Effect on surface layer of lakes and oceans 53
  Effect on wildlife 15
  From microelectronics industry 73
  From road salt 78
  Great Lakes 47
  Groundwater 50
  Historical problems 73
  Lake Tahoe 88
  Law enforcement 76
  Milwaukee sewer project 49
  Nonpoint sources 36
  Penalties 54
Weather
  Drought 4
  Effects of volcanic eruptions 3
  Global warming 3
  Precipitation 5
  Severe storms 4-5, 39
Wetlands
  Florida Everglades 41
  Louisiana wetlands 37
  Upper Mississippi River 58
Wildlife
  Animal behavior 11-12
  Care of infant animals 17
  Game management 107
  Habitat in residential areas 41
  Pollution threats 86
Wildlife Conservation
  Bird habitat 14-15
  Captive breeding 11, 16
  Elephants 12
  Gorillas 27
  Habitat protection 58, 87
  Marine 46, 51
  Preservation of species 14
  Refuges 17, 39

> *"Whatever befalls the earth befalls the children of the earth."*
>
> CHIEF SEATTLE, 1854



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